HDK-VALAND – ACADEMY OF ART AND DESIGN

SIGNS OF SENTIENCE

Metal portrayed as alive material

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Contents

Abstract

My exam work is a sculptural object with interpretation of steel being alive, which shows signs of organic growth. The purpose of the work is to oppose the popular idea that steel is just used for tools and constructions, and to portray a sentient mass that has a will of its own.

I have always had a fascination of natural forms and my previous projects during the program has had the common theme of portraying growth. The idea of metal being sentient can be found in philosophy called “panpsychism” where all matter is believed to have mind-like aspects. With a background of learning the craft of blacksmithing I have acquired skills and techniques to shape metal. There is a dialogue of sorts between the material and the person who shapes it.

My goal has been to create one artwork that contains signs reminiscent of life and to explore ways to show the contrast between the forms that portray the metal being alive and the forms that seem lifeless. I wanted to emphasize on the power of growth and the strength of the material.

My process started with sketching on paper. My final sketch on which the sculpture is based has the wanted feel to it, but I have had an open process working with the material to reach the final result. I have experimented with different techniques to form my desired shapes making sample pieces and developed the three-dimensional forms as the project advanced.

When presenting the work, I got feedback from professional artists. Among other comments it was said that I managed to capture a lightness of a living organism in the work and that the sculpture could not have been made from other materials, which was one of the main points of the work. I also exhibited the sculpture in a central venue in Gothenburg together with my fellow graduates.

Although it was an ambitious project within the given timeframe and an exhausting process, the struggle I put in to creating it gives it strength and this carries through life as a strength of growth.

Key words

Growth, Sentience, Living metal, Contemporary art, Panpsychism, Craft, Art, Metal Art, Steel, Sculpture, Blacksmith

Introduction

In this work I want to bring out aspects of steel, a refined material that is used for construction and tools, that show signs of it being alive. It is, admittedly, a very abstract concept since metals are seen as manmade and non-living materials. A good contrast to this is organic matter. For example, a plant that grows and expands its cellular form by absorbing carbon from the air, or a fungus, that spreads its spores via a mushroom. Both have a dormant state, a seed and a spore. What if a chunk of metal is at a dormant state, waiting for the right conditions to reveal its growing form?

In this document, I will cover my background, context and motivation for the work and describe the framework, the process, and the aftermath of the project.

Background:

My fascination of natural forms

I have always had a fascination for nature, that is both the living and the non-living, plants and stones alike. Before I used metal as a medium, I was drawing and painting works with nature motifs. Drawing has been a great tool to find forms that please the eye and to visualise concepts and entities that are too abstract to explain with words alone.

Previous education and experience

Preceding the start of my bachelor studies at HDK-Steneby, I was studying for two years at a metal program in Omnia, a vocational school of handcraft in Finland. During this education I got aquainted with blacksmiths through an internship, and later on I worked for a family of three blacksmiths for about a year. They taught me techniques and skills that have enabled my attempts to express myself in metal.

Previous works

During the studies at HDK, I have mostly made art with connotations to nature, but for a long timeI I was unable to pinpoint a connection between the works. Eventually I realized that this connection has always been a depiction of organic growth, judging by the flowing forms and living-like aspects. I find the phenomenon beautiful, and it brings me happiness, and it also inspires me to grow as a person.

The word “growth” is used for a gradual development in maturity, age, size, weight, height, number, etc. (“Growth”, n. d.) It is also used in the negative context of cancer or overpopulation. From my artistic perspective, the word “growth” means something living, or bordering sentience, that has expanded itself in some way through a will or a purpose. The structure that growing entities share in one form or another is that they start from a seed, which is dormant until the right conditions occur They also establish a presence with the environment by growing, which ensures survival and enable thriving.

The first growth-themed work I ma de was during the Memorial Sign course in my first year of the studies. I had problems starting the physical work according to the drawing I made, because it had no concrete information on how to make it, such as dimensions or technique. I was given an idea to first create a mannequin, a skeleton of sorts for the work and build up the work according to that, which worked perfectly with the feel and the concept of the design.

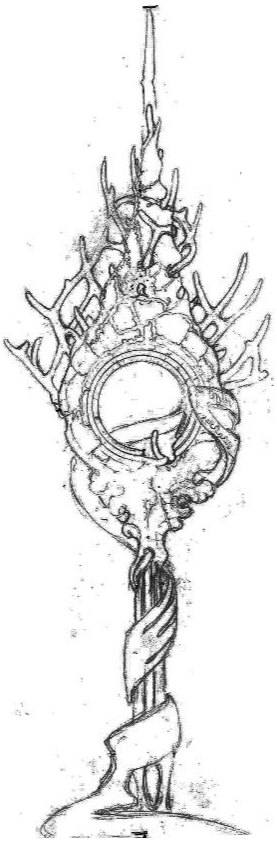


Figure 1. Memorial sign sketch

Figure 2. Memorial sign "Grave of Paths", Photo by Heiner Zimmermann, 2019

During the end part of my second year, I could not access the the metal workshop due to the lockdown caused by Covid-19, so I carved stone instead. I worked without a preconcieved image for a sculpture and tried to see what forms the stone would encourage. Although I visualised intuitively forms reminecent of living beings, such as mushrooms or slime-mold, the forms of the stone steered the way of carving it.

Figure 3. Carved stone -sketch

Figure 4. Carved stone sculpture

My last project that led up to this one was about exploring a method of working within the wide theme of growth. I have struggled with my process vs my ideas, so I was trying to find a cohesive way to work with the material and my ideas in balance. One of the issues was an idea that the material has a purpose according to its shape; A chunk of steel, especially one that is a leftover of a previous process could be repurposed by using its outlines and dimensions. Alongside overthinking and -analysing, this idea made me try to find the best possible outcome without "ruining" the material, which would stop me from using the material in the first place. I managed to disable this by creating a tool that made copies of the same form. Then I could play around with the material without compromising ideas that were born from the form.

Figure 5. "Seed of an Idea" nr1

Figure 6. "Seed of an Idea" nr2

Natural forms and metal

Among architects and designers, steel is still widely regarded only as an extruded material for industrial use. After the second industrial revolution around the late 1850, working with steel became far faster than it ever was. New techniques made it possible to produce the material for architecture and machines. This was a grim time for craftspeople, whose work was made almost obsolete by mass production of machine-made items. (Industrial Revolution, 2021)

In the terms of craftspeople, material has its own language. It works in a certain way, enabling the person using the material with properties that make it possible to create forms. On the other hand, it restricts from using the material freely, making it difficult to shape and taking a long time to master the techniques. There is a dialogue of sorts between the material and the person who shapes it.

Natural themes have been used in arts and craft throughout history. Most notably Gothic cathedrals, such as Notre Dame display ornate ironwork which is all done by hand. (Gothic Metalwork, n.d.) At the start of 1900, the Art Nouveau -movement was at its glory, where botanic forms and harmony of nature were back in spotlight after the industrial uprising. It was also a time when craft was brought back to life as a part of interior and exterior elements. (Art Nouveau, 2021)

Instead of using metal for its industrial qualities, I want to create art with metal by using natural forms in an abstract manner. To highlight the material's own language, I use the quality of strength in creating voluminous entities, which are lighter than a fully solid mass and still have the metallic feel and sound to them. I believe that no other material can achieve this the same way as metal.

Science and philosophy

In the society that is driven by scientific evidence, the material world is commonly divided into living and non-living matter and entities. Consciousness is also a widely accepted phenomena, but there is no way to explain it's source with contemporary scientific methods. There is a so-called "hard question of consciousness", which is: How can matter, such as a human or an animal, have a subjective experience? The question remains unaswered. (Hunt & Schooler, 2019)

Panpsychism is a compilation of philosophies that claim that the universe contains mind-like aspect, both in the living beings, like humans, animals and plants, and in entities considered non-living, such as stones or water. The idea is getting increasingly popular as the ideologies of materialism and dualism show flaws regarding the understanding of the origins of consciousness. (Goldhill, 2018)

A claim that borders this ideology was made by the inventor and electric engineer Nikola Tesla, quoting:

"In a crystal we have clear evidence of the existence of a formative life principle, and though we cannot understand the life of a crystal, it is nonetheless a living being." (Tesla, 2021)

Reference artists

There are many artists who have nature as their main source of inspiration. I choose here to reference artists that have a style and technique that are relevant to this project as well as being inspiring to look at.

Brazilian artist **Henrique Oliveira** creates large installations from recycled wood that portray the force of the organic mass, while taking full use of the space where the works are placed to. Depicting the force of growth is something that I want to pursue, which is why Oliveira's works are inspirational.

Figure 7, Henrique Oliveira, "Tapumes" (Kimberly, 2009)

Junko Mori is a metal artist, who works with the theme of uncontrollable beauty of growth. She creates works with singular or multiple types of units that adds up to a greater, unified form. The way Mori works is mimicking how organisms expand by dividing and multiplying, which is an important aspect in the theme of growth.

Figure 8, Organism 2010 (Anderton, 2011)

Project description

Purpose

The purpose of this project is to create an artwork from steel with signs of it being alive. As an artist and a craftsperson, I want to show that the material has a more artistic value by itself, that it has a presence rather than just being the means for making a construction or a tool. The main audience for my work is people that do not have knowledge about metal arts of craft, and my intention is to show qualities of an organism in a material that they might consider a still and manmade contrivance.

The work has one part that shows the starting material, a simple block of steel, and a second part that shows it's growth. I'm going to explore ways to show growth with organic forms found in nature. These forms are not an exact depiction, but more of an abstraction from existing living organisms. The difference between the simple shape and the organic forms are meant to hint at the aspects of the non-living and the alive.

The work is meant to be approachable with all senses, and to have a powerful feeling to it. It is both a portrayal of the material's own strength and showing the force of its growth. These factors are assessed with size and volume of the piece, both being near-human scale.

Goal/Objective

- To create one artwork that contains signs reminiscent of life.
- To explore ways to show the contrast between the forms that portray the metal being alive and the forms that seem lifeless.
- To emphasize on the power of growth and the strength of the material

Questions

- How do I create an art piece from a drawing that does not tell me exactly what I should do?
- How can I communicate aspects of sentience with forms in steel?
- How can I show characteristics of steel within the organic forms?

Approach

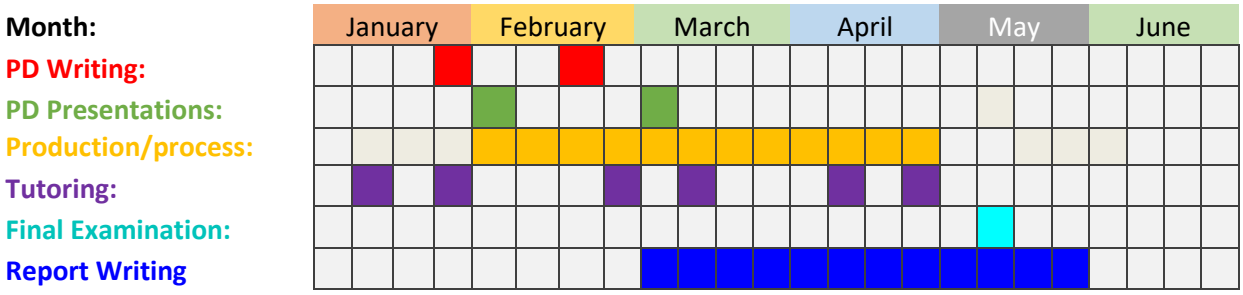
The work will start with sketching. I find it faster and more free to explore forms in two dimensions rather than with material. Once the forms are established, I will try to find the best solutions by experimenting with the material. The initial idea will give a direction to work towards, which is easier than having a complete freedom. I will abstract natural forms into the paper and see if they have a flow that pleases my eye but does not seem like impossible to create in the allotted time. Once I am content with a design for the work, I will use it as a base to create an artwork. The sketch gives some idea of

the materials and techniques I will use, but it will not specify anything. I will leave some time for experimentation, but I must make quick decisions to keep up with the timeframe. This way the work becomes both challenging and interesting to actualize.

The focus of the design is the contrast of the living and the non-living matter. Secondary focus is the difference between the starting material and signs of life. It is important to me that the work is pleasing to look at, which is why I must observe the proportions in the drawing carefully, but also give the work itself room to evolve with the material.

The forms that I create to depict sentience can be associated with seedpods, fungi, insect parts, etc. The abstraction of these forms makes the idea visible, but not recognizable as anything specific. The emphasis is in showing the growth and the strength of the material that can support itself.

Timetable



Process

Sketching

Before sketching, I had not decided a theme for the work, and I wanted to keep the process open. After a while of sketching, I was a bit lost on the vastness of forms and visuals, so I narrowed the theme to material's own livingness. I drew multiple sketches and continued until the visuals felt right.

I did not want to make the drawing into a blueprint, but to follow the drawing as a guideline for the feeling it evokes. I wanted to keep the process open for interpreting the drawing, having only a vague idea on how to construct the entire work. This meant that I would have freedom of experimenting with the way of making it without being tied to a technique. Keeping the framework vague is risky, especially if you have a limited time to actualise a work, but it keeps things interesting. There is a complexity to the work that cannot be fully understood before the process of making. If the work was based on a blueprint, it would have been too static and thought through, which would kill the purpose of the piece. Figures 9-12 are examples of my sketching process and in figure 13 you can see my final sketch on which the sculpture is based.

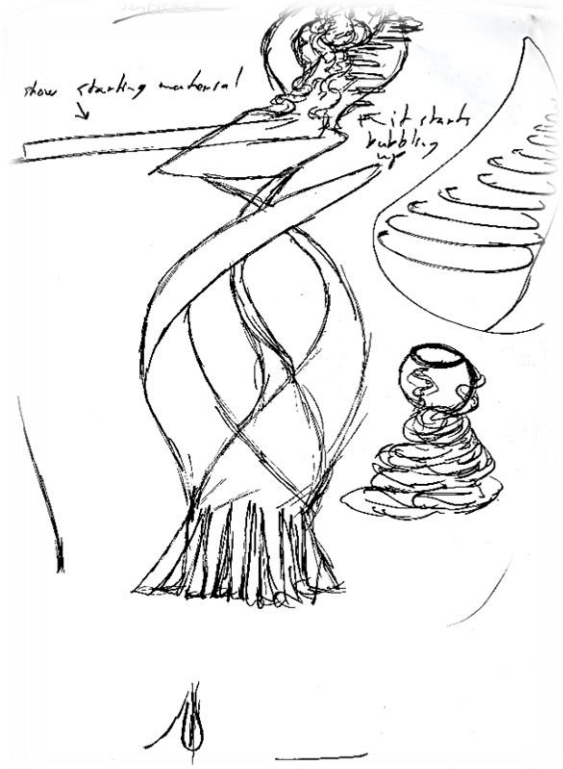


Figure 10

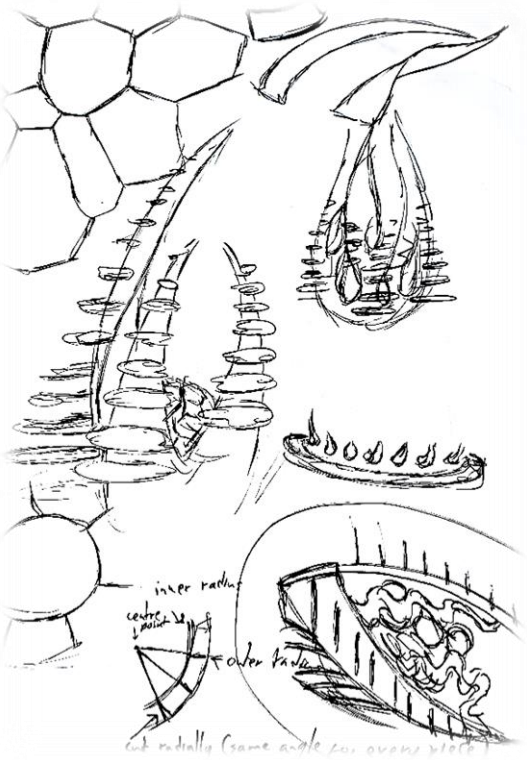


Figure 11

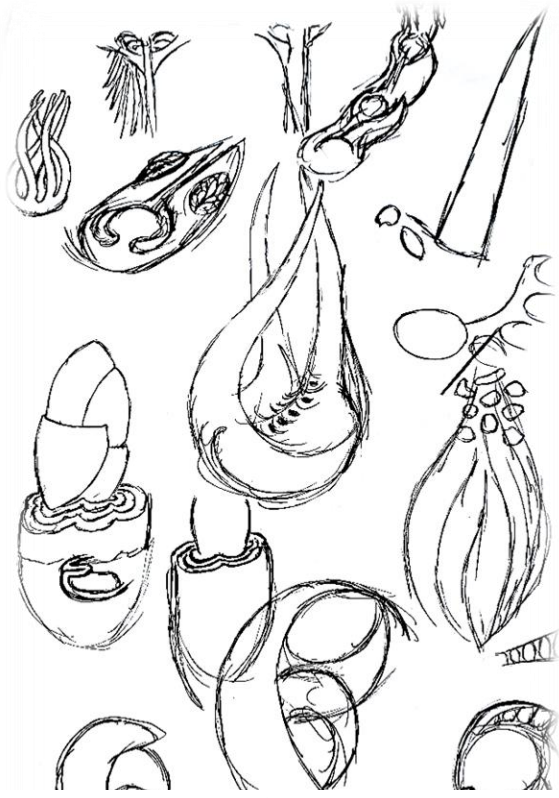


Figure 9

Figure 12

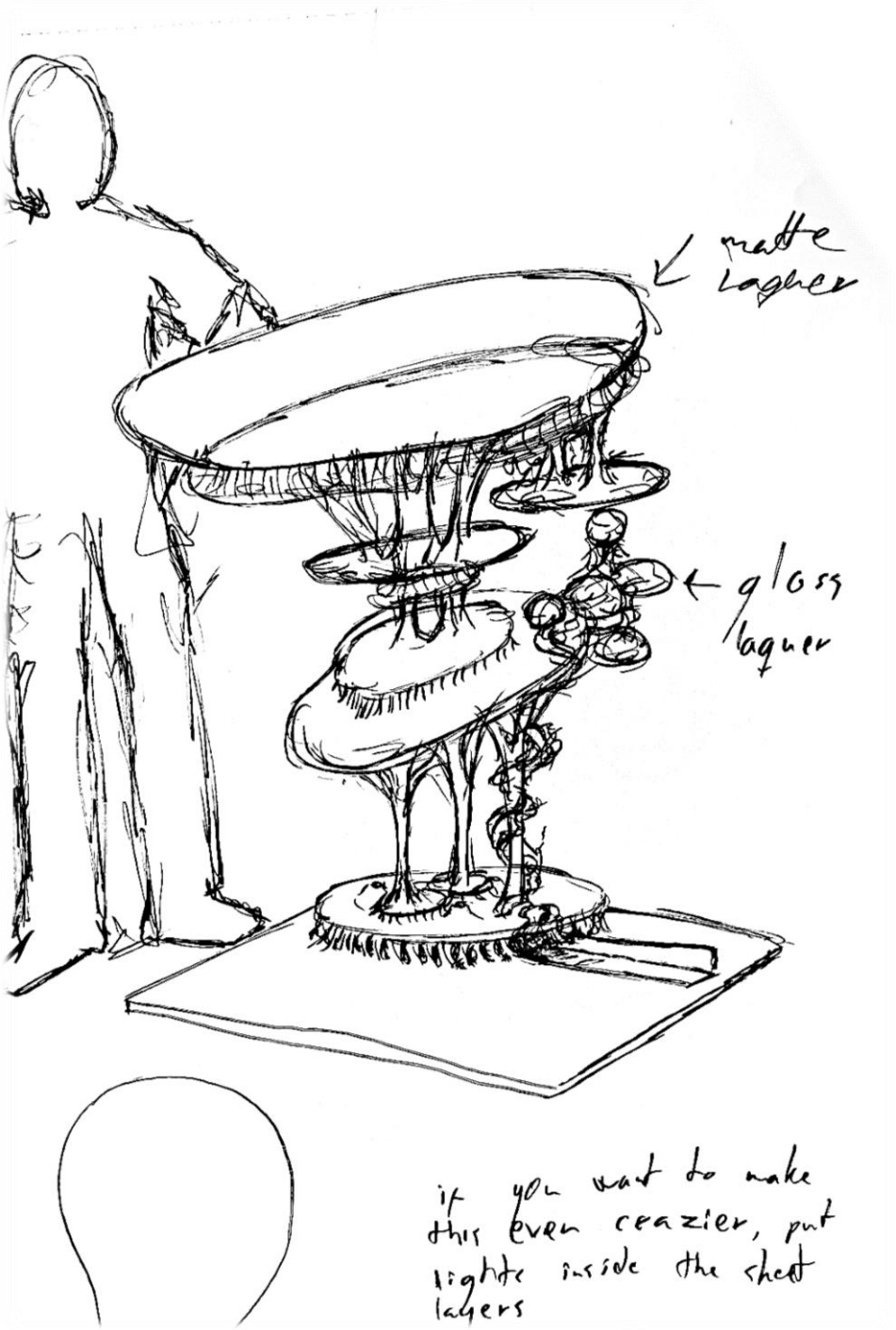


Figure 13 Final sketch, 2021

The final sketch had similarities to a mushroom or a slime mold, but also with architectural elements, such as layers with pillars. The choices for the forms come subconsciously, but if I break down the forms, the layers represent multiplying, the membranes in between are airy bodies, and the branching pillars elevate the mass to new hights.

Start of production

The drawing contained two sculptures in one, and some details that were optional, so I focused first on creating the large main body. I started from making the most visible forms in the drawing, which were the pairs of plates. I made a silhouette drawing of the piece to see the proportions of the plates and loosely calculated their real size. I used a plasma cutter to create the uneven oval-shapes quickly and refined their edges via grinding. See figures 14-15. I made a smaller sample piece to see how to approach the “membrane” parts in between the plates. See figure 16.

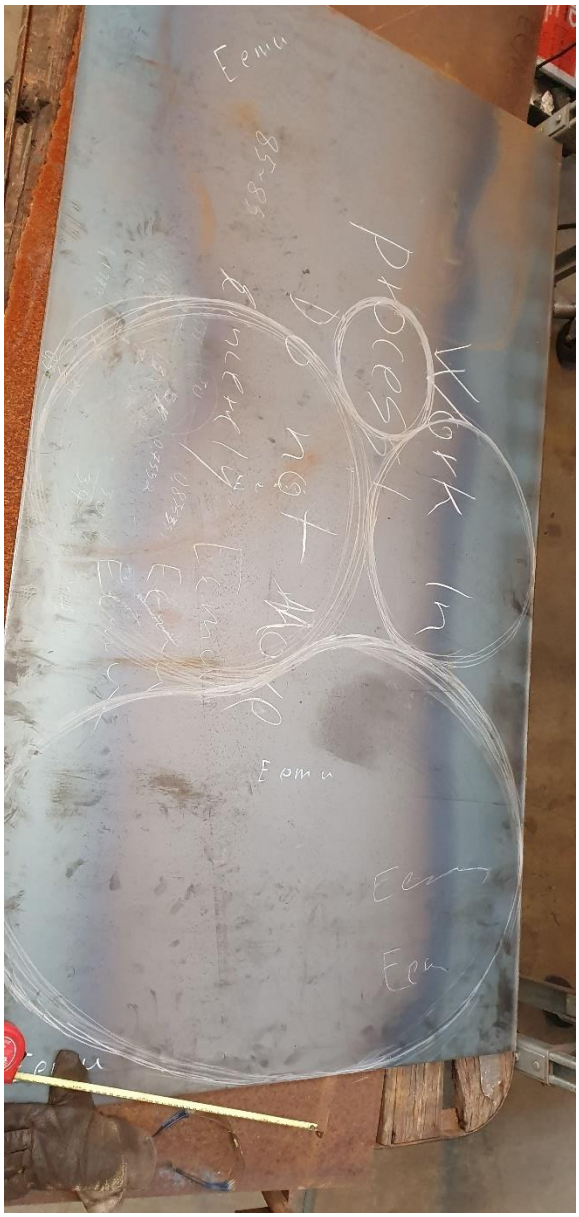


Figure 14

Figure 15

To create the desired outlook of the membranes in between the plate-pairs, I came up with a sort of BBQ-tool (see figure 17): I would attach a handle and use the propane-oxygen torch to melt the parts in between the plates and let the gravity pull the molten metal towards the right direction. The tool would allow me to rotate the piece to go through all the "membrane" bits faster than if it was attached into a vice. Some of the plate-pairs would be heavy, so I had to make the construction stable enough. I tested this with the sample piece, and the technique worked. It was not as clean as I wanted, but I decided to continue with the initial plan.

Figure 17 BBQ tool

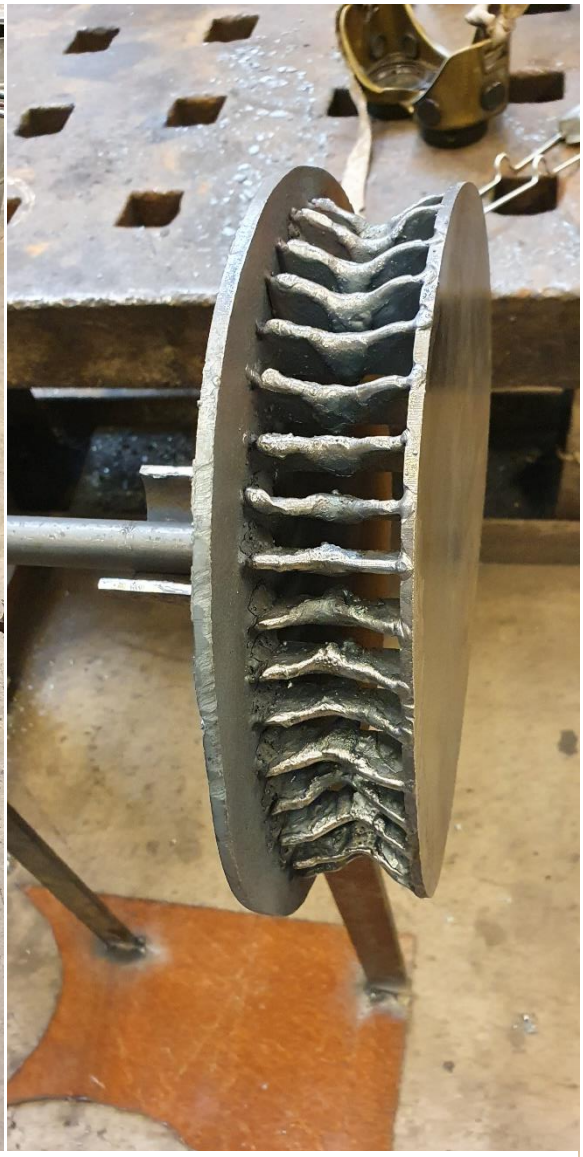


Figure 16 Sample piece

Production

Welding the membrane-parts into the plates took a while. In total there was 454 pieces of steel sheet. Alongside this, I was trying to come up with the best way to make the pillars. To make a smooth curve into the plates, I thought of bulging and punching through them, since the material's thickness would allow it, and there would be less cleaning of welding marks than when welding the parts directly to the perpendicular sheet.

Figure 18 Some of the membrane welds

I was figuring out the details of the pillars I put in between the pairs of plates. During this I realised that I needed to know how many punctures I had to make into the plates before welding those together. Even though I managed to sketch a satisfying detail for the pillar's upper parts, it is difficult to see multiple directions of the pillars and all the points it is attached to by just drawing, and to see that it works in 3-dimensions without cluttering the work or being too simple. I concluded that bulging only the lower part of the pillars was the best option.

Specifying the forms (and proportions) for the pillars has required me to make a pile of parts that I can use. After assembling some of the pillar parts together, I figured out a 3-dimensional form for them. The exact proportions of the pieces require the placements of the bulges, so I had to make those first.

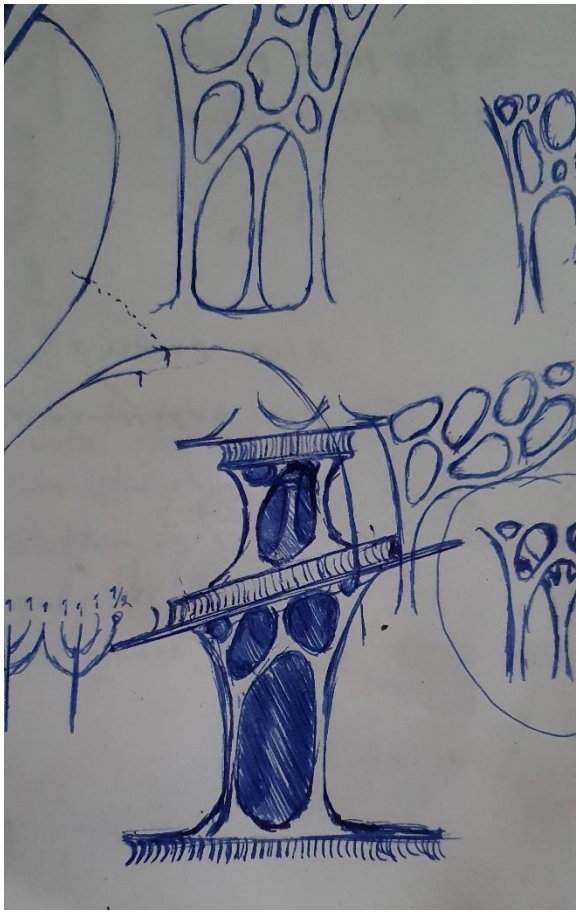


Figure 19 Pillar detail sketch

Figure 20 Pillar parts

The bulging of the plates worked with one upper tool and a lower circle tool. I marked places for the bulges, clamped the pieces when the ring was set in the right place and heated up the area of bulging with an oxy-propane torch. The heat contorted the material a bit, so I had to straighten some of the plates.

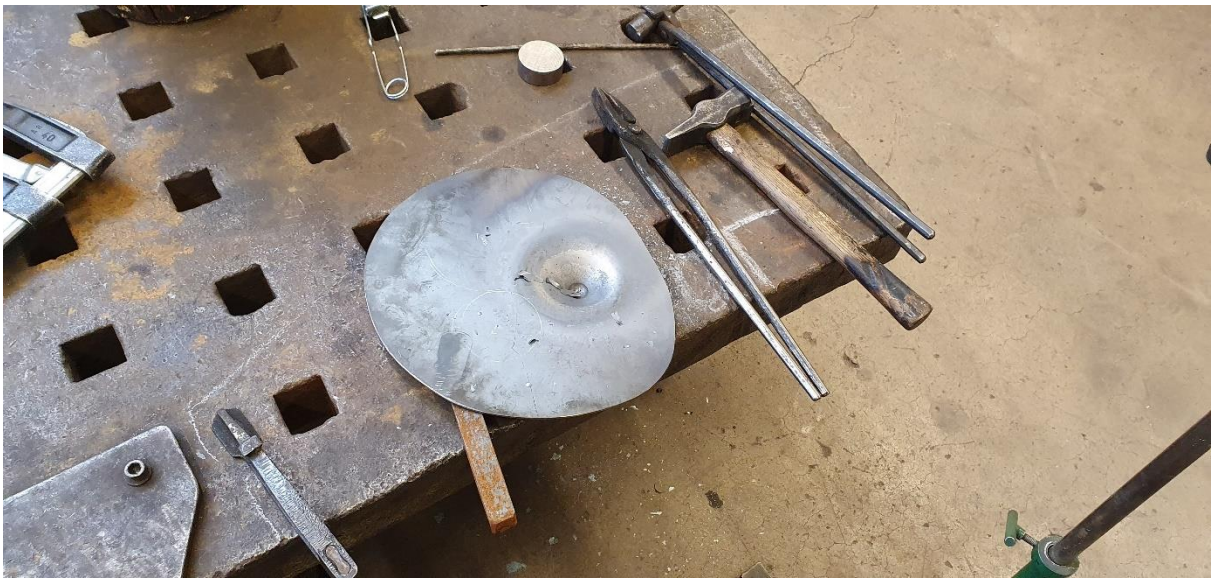


Figure 21, Plate bulging

Figure 22, Pillar branching test

Figure 23

One of the bulges had a crack, which made me realize that the bulging might weaken the material and might not be able to take the full weight of the pieces attached above it. I had to make pillars inside the plate pairs to counter the problem (see figures 24 and 25). The pillars had to work with the visuals, so I forged them in the same manner as the others.

The problem in making these pillars was that they had to be welded inside the plate pairs before welding the sides, and that they had to be the correct length with each bulge. I solved the problem with an idea of making holes into the bulges, so I could see if the inner pillars were in the right place.

Figure 24

Figure 25

Before I began to combine the plate pairs, I had to clean a bit of the inside where the membranes were. I thought that if someone would peek in between the plates, it would be more satisfying experience without marks from welding. I clamped the pieces together, since the sides with teeth had warped from welding, and welded all the pairs together.

Figure 26 Inside a plate pair

Figure 27 Welding the bottom part

The initial idea was to melt the sides to create an organic look, and I started with the smallest and easiest of the plate-pairs. I had not experimented much with the torching, and the result was somewhat underwhelming. The teeth had an uneven curve and a bit too gritty look to them after melting them with the oxy-propane torch. The torch was using oxygen much more than propane, which burned the surface.

I decided to experiment with the piece to find a better result. I welded additional lines to the upper side of the plate pairs. I then used the plasma cutter to sculpt away uneven bits and excess welding marks. I used a smaller oxy-acetylene torch to melt the surface of the “teeth”, which became much smoother than with the large torch with the cost of taking more time. The plate pair became a bit better, but still had some roughness. I decided to keep it as it was for showing some of the struggle.

Plasma cutting and torch- melting seemed much better option than just melting, so I cut the membrane-parts with plasma cutter. After melting the second smallest piece, I discovered that I should have cleaned chunks of iron oxide caused by plasma cutting before I melted the material. I used a punch to get rid of them, both from the already melted and the non-melted membrane-parts.

Figure 28 Sculpting with the plasma cutter

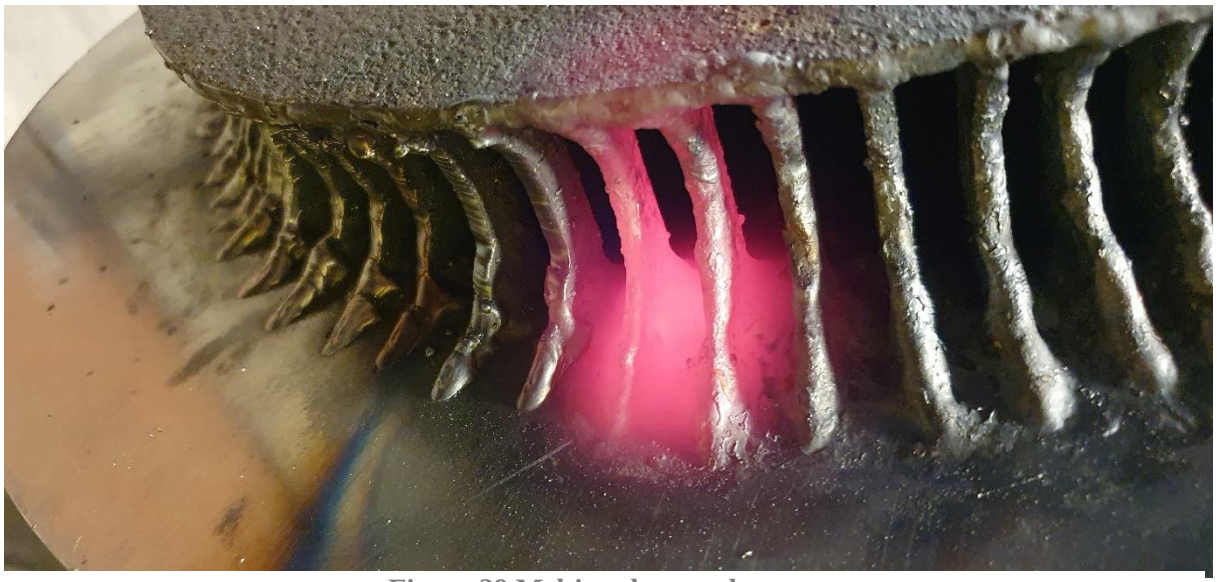


Figure 29 Melting the membranes

Figure 31, Largest plate pair on the BBQ-tool

Figure 30, Melting the membranes of the largest plate pair

Cleaning the pieces and melting the edges was a long and exhausting process. Even though melting metal was very satisfying process, it was tiring for the eyes (to the point of tears!). After talking to multiple people, I concluded that I must change the pace of working and start analysing the piece. Looking back to the initial idea, my sketch with seemingly two sculptures in one, I decided to leave out the squiggly shape, as it would clutter the piece and consume time which could be used in a better way.

Finishing the piece

I have tried to assess two major technical questions, which would ultimately affect the work and how it is seen: surface treatment and the base. On top of this the base was crooked by heat from welding and torching. I tried to straighten the baseplate, but the welded pair would have required a lot of heat to be adjusted, and that would have risked collapsing the membranes. There was a consideration, after many comments about the baseplate, that I should put something sturdier underneath to stabilise the piece completely, but I was not sure if it would affect the portrayal of the idea negatively. Some people also commented about the rectangular shape clashing with the organic ones, which was not so straight forward for me.

I pushed away the pressing questions and went straight for the assembly of the piece. It went more smoothly than I had anticipated, but there was a lot of filling of gaps and adding material to spots where the pillars were not long enough. Setting the plate-pairs was also less cumbersome, as I welded them first onto spots where they were in balance. Only with the last and largest plate-pair I needed help to position it in a way that it looked good, which I received from Janne Peltokangas. After the assembly was done, I realized that the piece was high enough to be tipped over if someone wanted to, which made me think of the base again.

Figure 32

Figure 33

There was a lot of cleaning to be done before the pillars would look smooth. Plasma cutter was saving a lot of time on shaping the pillars. The grinding was straining and took a long time.

After some thinking, I decided to make the base of the piece seem thicker. This would make it more stable and less subtle. I heated and hammered the base to make it wavier, which was to amplify the effect it already had. Then I welded plates to the sides of the base and used plasma cutter and grinder to have a clean transition of the wavy top and straight sides.

Figure 34 Base before grinding

I also came to a conclusion about the surface treatment. I decided to give it an even rust surface. Rust is a naturally occurring layer of iron oxide, which is a side product of corroding steel. This also slows down further corrosion. It fitted the theme of the work as another aspect of steel's behaviour.

Before I could apply a rust surface to the piece, I had to clean it thoroughly. The best way to clean metal to have a homogenous surface is to sand blast it. I had no possibility to do this by myself in the university workshop due to the size of my piece. I asked for help from Björklunds Bläster och Måleri,AB, a company which had a sandblaster in a large tent, and they cleaned the piece very efficiently.

When the piece was back in the workshop, I immediately sprayed it with a mixed solution of vinegar and salt. The first reaction was very interesting, because the sandblasted surface did not turn rust brown but dark green (see Figure 36). On the second spraying it turned dark brown, and beyond that it developed an almost even surface.

Figure 35, Sandblasted work

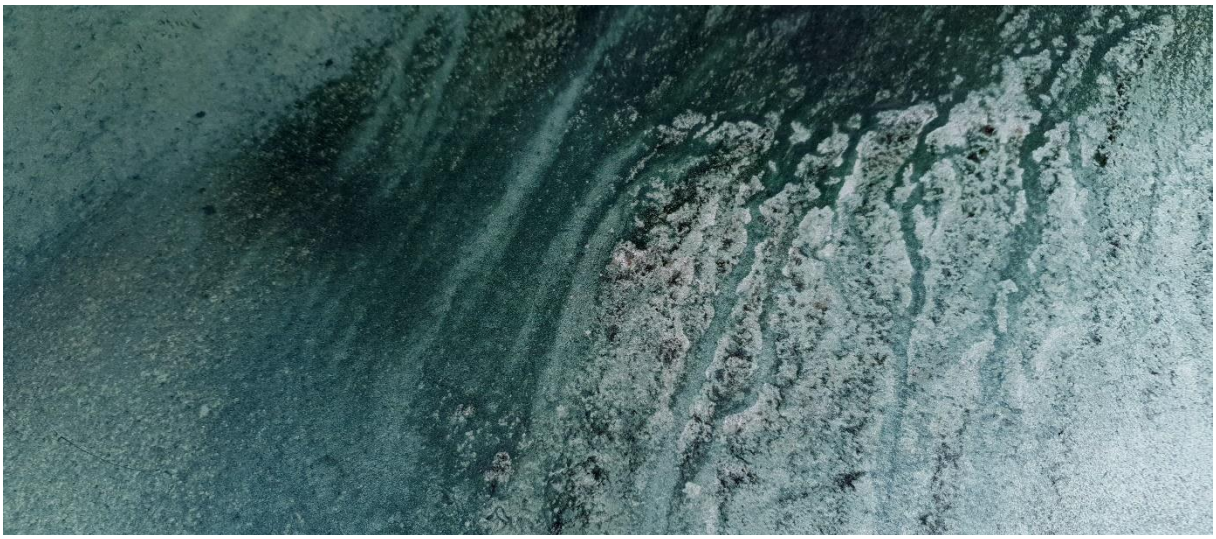


Figure 36, Green rust

With multiple times of vinegar-salt spraying, I had to neutralise the surface to stop the rusting further. I used water and baking soda, which made white marks into the piece upon drying. I washed these away with running water, and after drying the piece it turned into a colour of vivid orange.

As a last touch, I sprayed the piece with matte-lacquer to seal off the surface. The main reason for this was that I wanted people to experience the piece, not only by looking but touching and hearing it. The surface was very sensitive to touch, so without the lacquer, touching would take a layer of rust away but also spread it to the person's hand and clothes. With the help of Filip Schmidt, Wictor Eldervik and Daniel Freyne we set the ready piece beside a white background and Daniel Freyne took good pictures from angles which my tired eyes would have not noticed.

Figure 37, Finished work by Eemu Kaikkonen, Photo by Daniel Freyne, 2021

Discussion and reflection

The work has been very much based on the wanted result, which has been an interpretation of the outlooks of a drawing. Due to the limit in time, I chose to work with techniques that would work to achieve the pursued forms, partially decided beforehand and partially through experimentation. This has included sculpting and grinding, both of which are processes perhaps more suitable for materials that cannot be shaped otherwise, such as wood or stone.

There were also aspects in the process that have a strong connection to craft and tacit knowledge. One such was the melting process, which has been intuitive and required a sensitive dialogue with the material. It required heat and gravity to steer the material around, but also seeing where it does not want to go and persuade it a bit. This has made the membranes much more living in their visuals. The other one has been the inevitable warping of the sheet during welding, which has made waves everywhere on the plate pairs. This is especially visible from the base of the piece due to its voluminous outlook. The third one was the rusting, which did not become entirely homogenous, even with the sandblasted surface.

During the construction process, I had feedback from fellow students. There was a question about the base, which at the time was just a rectangular sheet of steel. I had thought that it was evident from the rectangular shape and similarity to the structures found from the work that it was a block of material where the growth had started. I had thought it would work as a conventional base, which would not need any other platform underneath. Others did not see this directly, because it was too much of a platform for the work rather than part of the work. This was interesting, because I was convinced that combining conventionality with the theme would enhance the effect, but it did the opposite! I mitigated the problem by making an illusion of a bulky base instead. This was more visible, which made the contrast of the growing and the still material more evident.

I had sessions with our programmes internal tutor Tobias Birgersson and examiner Heiner Zimmermann, both of whom had great insights about the content of my work. One aspect that I can remember very well from our conversations is the balance in the proportions of the work, which portrays the contrast of the still material and the living part. If I wanted to have the concept shown clearly, I could have made the part that grows much smaller and still get the message across to the audience. The aspect of showing the strength of growth, however, would not be as evident. These two factors seem to clash similarly like the conventional base and the showing of starting material.

Marcelo Gustafsson, a jewellery artist, and an object maker, worked as my external tutor, and helped me find ways to put my work into different contexts. He challenged me with questions, which I still have not found a clear answer to: Where does the work belong to? What environment would the piece fit into? I can answer more easily to the question: where does the piece not belong to? It does not fit inside a domestic house, as it needs space around it. It does not belong outside of reach, because experiencing the piece is much more enriching if it can be touched or heard. It wobbles when shaken, it sings when pounded, and the smooth and membraned surfaces feel pleasant to the touch.

Another difficult question was: Is the work a sculpture or an object? Since the piece is meant to be inviting to be experienced with more senses than just visually, naming it an object would make sense. At the same time, it is not in the same level of movability or as easily held as most everyday objects, so that would make it more of a sculptural piece. Sculptures can also be tactile, but often less inviting than a handheld object. At this instance I will call it a sculptural object.

After presenting my work in a formal examination presentation, I had the honour of getting feedback and talking to opponents Sabine Straub, a German artist working with metal art in public spaces, and Vivi Touloumidi, a Greek jewellery artist working with body related art. Sabine was my main opponent, and according to her I managed to capture a lightness of a living organism in the work. She also said that the sculpture could not have been made from other materials, which was one of the main points of the work. Vivi commented on the aliveness of the piece and pointed out that it could host a living colony of beings inside the piece. I had realized during the production of the piece how much it bears resemblance to the inner structure of a wasp's nest, and that it has elements that can be read as architectural components. This is not uncommon in nature, and people have mimicked organic structures because of how well they hold weight without becoming heavy themselves. Both opponents advised me to let the material speak more and leave some of the result to chance.

There was an exhibition that was issued by the university for graduating students from HDK-Steneby. This was an opportunity to find out how it would work in a specific gallery setup, and to see people's reactions to my piece. The exhibition place was in a greenhouse at the centre of Gothenburg. The space had different qualities, both good and bad. There was a lot of natural light, which is even from all angles and does not strain the eyes of the viewer. There were also many visible structures on the walls and the roof, which disturbs a full focus of the pieces themselves. Inside the building it seemed more approachable than if it would have stood outside, but most people did not touch the piece without separate invitation. This has given me some insight to the mentality of the public, although I need a longer time to come to a conclusion about the ease of approach to my piece.

Result and conclusion

The work was ambitious for the time that was given and was exhausting to create. It took three months from sketching to lacquering. Staring at the work constantly caused me to see a pattern in everyday things, such as a fence next to a road or a sewer, so the work was consuming me. At the last meters I had a nagging thought that I could have made the work infinitely simpler, and it would still work within the framework. This might be true on many parts of the work, but if I would have not pushed as far as I did with this work, I could not know this as certainly as I do now. On the other hand, If I did make the piece any easier to make, it would have compromised the powerful sensation that I was trying to portray. In a somewhat poetic way, the strength of the piece comes directly from the struggle of creating it. The force that I have used in making it becomes the strength of the piece. In the future the works might seem easier to make due to experience, but the time used to work with the material remains as a struggle in the past. This carries through life as a strength of growth

The feedback from tutors, opponents and peers have been most helpful throughout the process, for which I am thankful.

Eemu Kaikkonen

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Image index:

All the figures are photos taken by me, and works made by me, Eemu Kaikkonen, if not mentioned otherwise in the references or the index.