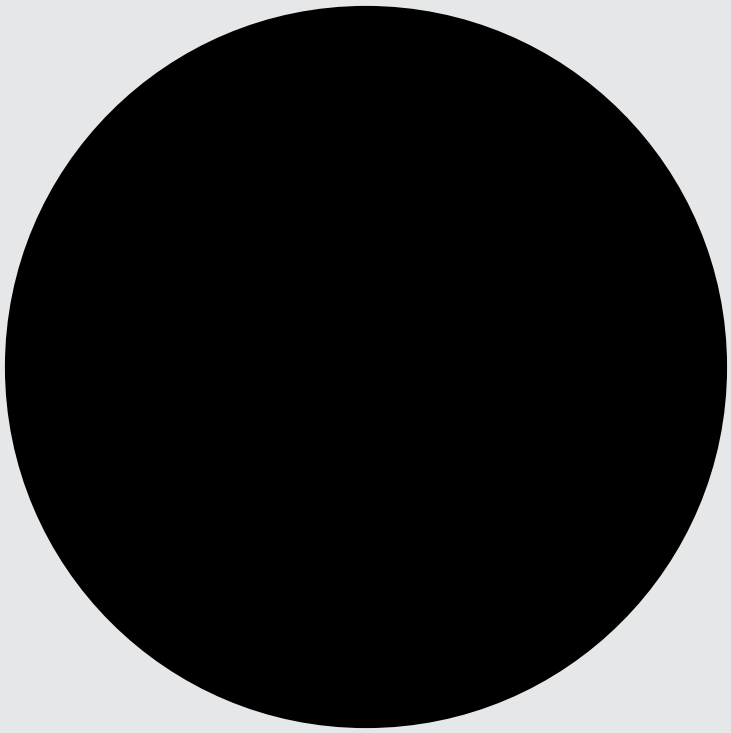
Finidng Form

Exploring the potential of generative design tools



A diploma project by Jingyu Kim & Philip A. Skånseng

Supervised by Steinar Killi

Finidng Form

Exploring the potential of generative design tools

Master candidates Jingyu Kim & Philip A. Skånseng
Supervised by Steinar Killi

Design diploma project, Spring 2020

Arkitektur- og designhøgskolen i Oslo
The Oslo School of Architecture and Design

Abstract

Designers are people who strive to make something beautiful and functional. They try to be unique in the vast landscape of design. Throughout time designers and craftsmen have created many different methods and tools to make great forms in products. Such new attempts have been developed according to philosophies, historical periods, techniques and new tools available, influencing designers and giving us new forms.

Among these new methods we find a tool called generative design that has aroused our interest and curiosity. It is very different from the ordinary tools and their way of creating forms, these forms are more akin to something taken straight from nature.

This project is aimed at understanding what the new tool generative design is and what it can do for designers.

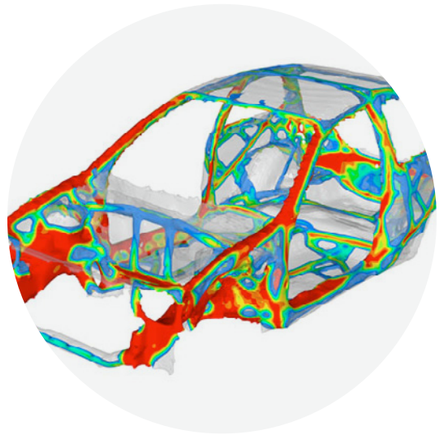
Motivation

Design starts with an idea, an idea that we develop and realize through methods and tools available. Most of our old tools are rudimentary and our methods will be in constant change, so it is sometimes hard to complete our idea to perfection, But now we have a new tool that goes through a vast amount of iterations and finds solutions we could never find ourselves. It answers our question for us.

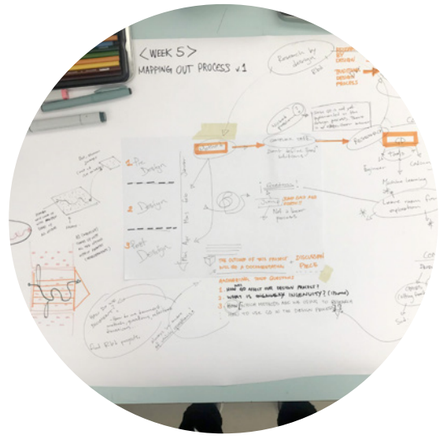
In this expanse of communication between designer and machine we see something new that we want to explore. The unimagined potential of augmented designers.

Journey

Desktop research, reading articles, papers and watching talks on generative design.



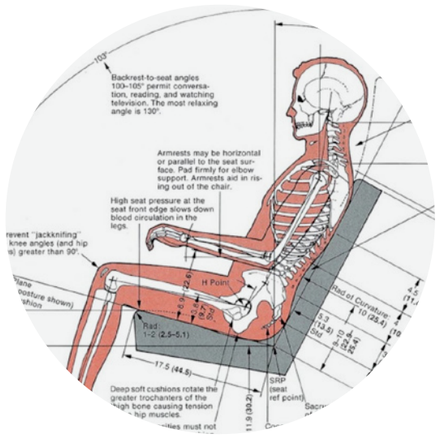
Exploring the generative design tools available to us and how it work.



Mapping outcomes and findings

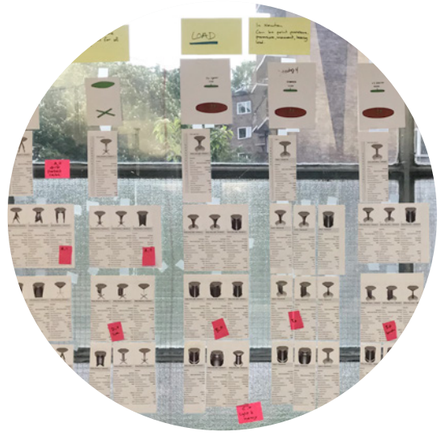
Exploring the potential of generative design tools in the generative design process.

Research by design. We want this to be an explorative project, unbiased to any outcome.

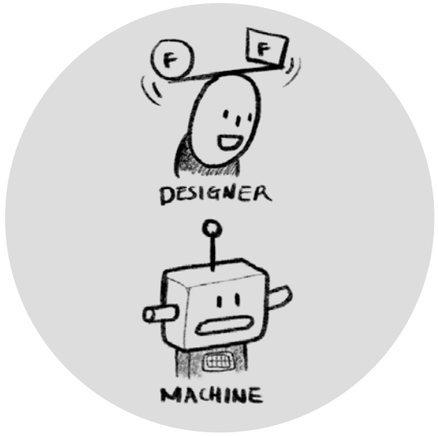


we chose the stool as the lounge chair becomes too complex and takes focus away from the tool.

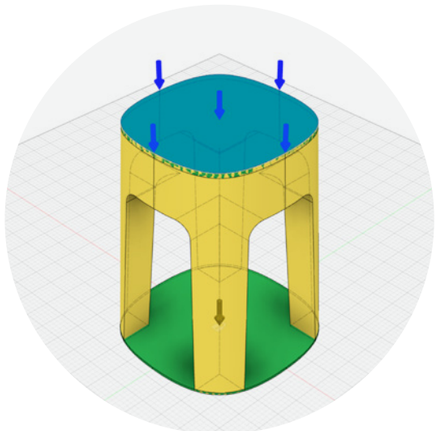
Adjusting tasks and focus. leaving Grasshopper and going for stools.



Mapping our findings and creating an overview of our project.



Creating scenarios for better understanding of the cooperation between designer and machine. “The augmented designer”



Exploring Fusion 360 generative design tool, looking for the flow between designer and tool.

Reflections and afterthoughts.

Summary

Exploring the potential of generative design tools in the industrial design process.

This design project has been an explorative research into the emerging tool ‘generative design’ (GD). By designing products through the use of GD tools we explored the procedure and what is implied in use. The focus not being the end result but the process getting there.

We started out with desktop research and some interviews trying to find which tools are being used today, what they do and how they work.

Through testing different tools, we picked Fusion 360. We furthered the research by making stools and mapping out the process. The findings from this map showed us that designerly input was not only needed at the beginning, but also after the first results to further develop the stools.

We created scenarios to improve our knowledge of generative design tools in a design process and to reveal it for us and others. One story shows how it would work in a close to perfect scenario. The other shows where mistakes are made and a need for corrections and more input is needed.

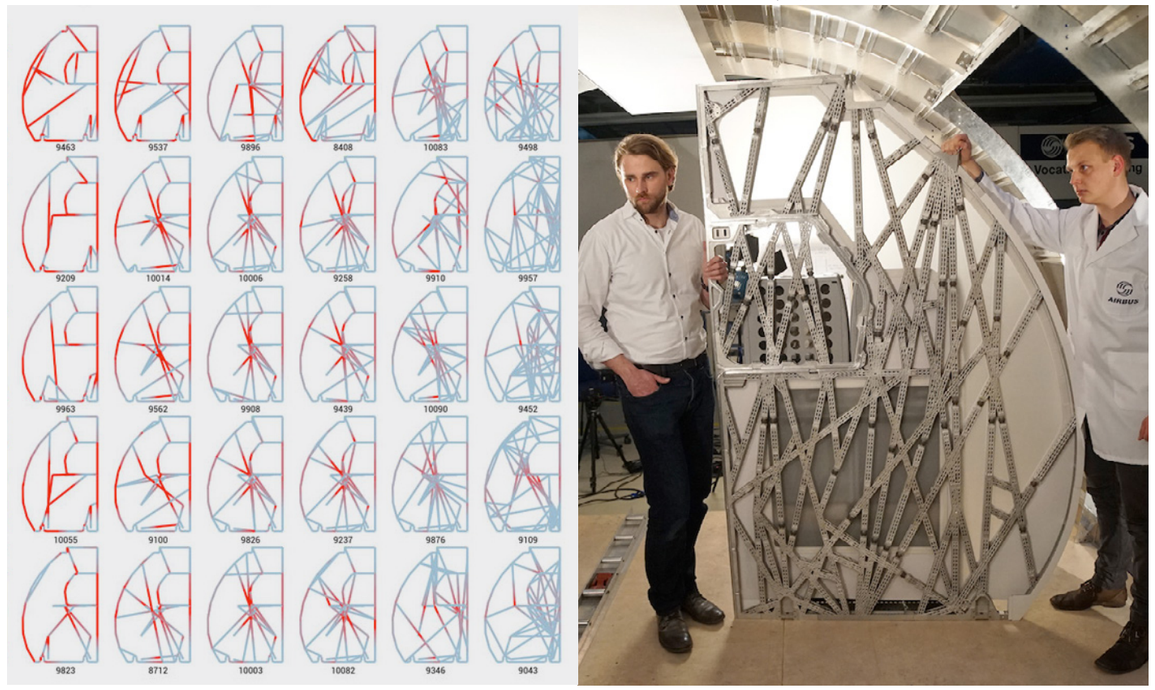
At the end, we reflect on our journey, findings and afterthoughts.

Table of content

Introduction

Designer Philippe Starck from France recently made the first chair done in cooperation with artificial intelligence (AI). He explains the experience as being in a conversation with the machine and as the first step towards a future designed by the machine. This statement causes controversy and argument. On one hand it awakes curiosity and excitement to an unexplored area of new technologies, and on the other hand, the fear of our jobs and of humanity in general. Can the machine really take over something as creative as design?

https://www.autodesk.com/customer-stories/airbus



The people at Autodesk, who are the foremost developers of A.I. and generative design, claims we are not far away from the everyday man designing for his own needs. Incidentally the people from Autodesk participated in designing Starck's A.I. chair!

We find this aspect of controversy very interesting, but for our industrial design project, we aim to look at what generative design can offer us today. What is this new tool, how does it work, and is it something that we can use in industrial design today?

There are already many projects done by generative design, in professions like architecture, engineering and art. And in this diploma we look into the process using generative design to the final product.

*AI Chair by Philippe Starck_*
https://adsknews.autodesk.com/news/starck-intelligent-generative-design

0.
STRATEGY

Methods

Research by design

This project is an open exploration into generative design and what it can perform for design. We did not expect a perfect product as our result, but rather to gain a deeper understanding of the tool generative design and what we can achieve by its use.

This diploma is a research through designing using the GD. Free to explore in any direction we find of interest as long as it has ties to our context, allowing unexpected turns that can help identify unimagined territory.

Panton Chair_https://lekkerhome.com/products/panton-chair-classic

Finding form

Seating furniture

An important task for the industrial designer is to balance function and form, ergonomics and aesthetics. When generative design is a function based engineering tool, we decided to focus on form and searching the form itself. Where are the aesthetics in the world of engineering, where function and structure is the primary goal?

Our project based on research by designing, we needed to choose a product to design. The results should have to be measured and compared. We considered various objects like lamps, vases and cutlery, but our choice landed on chairs. We considered seating furniture would fit perfect as it is a design icon and they have a good visual balance between function and form.

1. GENERATIVE DESIGN

3D printed steel knot developed by Bayu Prayudhi, TU Delft Architectural Engineering graduate
https://facadeworld.com/2016/07/08/3f3dnext-generation-printed-steel-knots/

What is generative design?

Generative design is a process that explores thousands of possible solutions in a defined space with given parameters. The context and parameters can be spatial requirements, manufacturing methods, materials, and cost constraints and they are usually set by engineers or architects. Generative design tools are based on genetic algorithms that in turn imitates Darwin's principles of how life evolves. This is why it often looks nature like in its shaping of solutions.

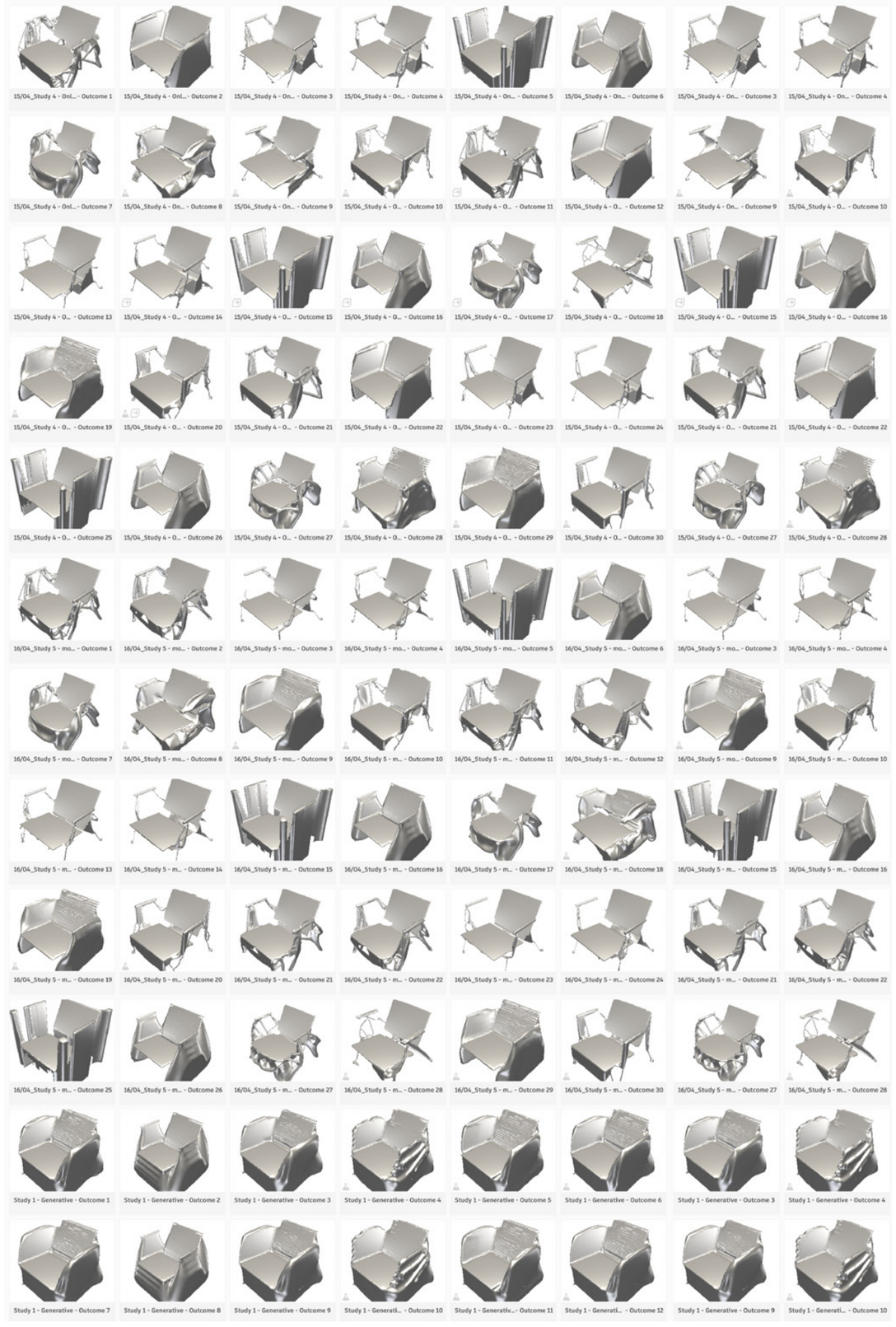
Generative design removes the guess-work from the geometry-creation part of the process. With generative design, you essentially tell the computer: "I don't know the solution, but I do know how to frame the problem."

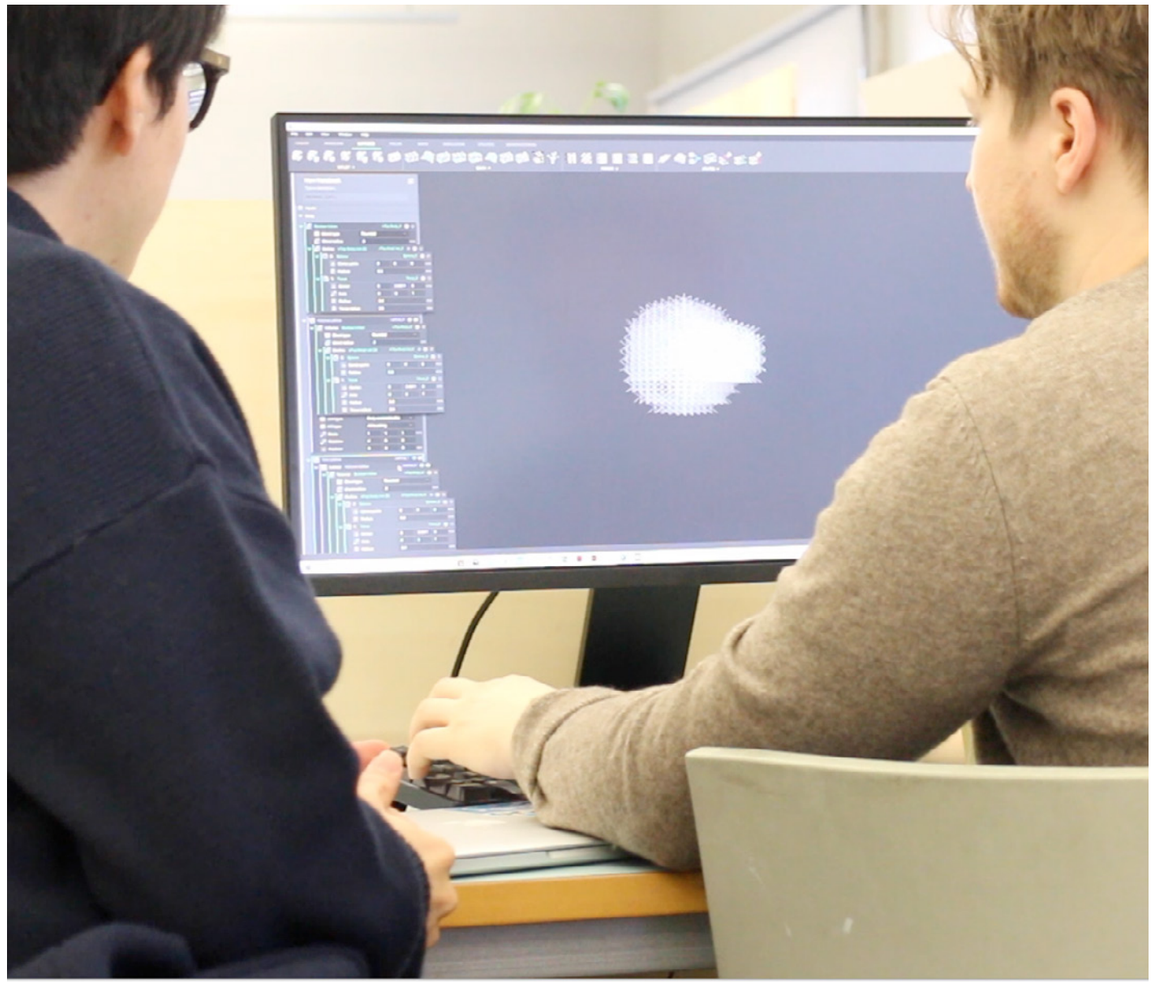
- Scott Reese I Autodesk

Benefits of generative design

Why generative design attracts attention is that it produces designs that are beyond the imagination of human designers. Because the generative design tool goes through every possible design option and finds the optimal result while the human designer checks only a few options. Another advantage is that it can reduce the human resources, time and cost we need and accelerate the product development cycle. This allows us to design in a more efficient way.

Even if generative design tools were developed more than 20 years ago, it still is in its early stage. However, the development has recently gained momentum as big data becomes easier to use and computing power advances. The threshold for using generative design tools has also decreased allowing end-users to easily access and use the tools. As many people use the tool for their design work, attention on this new tool or method is being paid to how it will change the design industry.





Tools available today

nTopology
OptiStruct
Toska
Truform
Fusion 360
Grasshopper

There is a wide range of tools on the market that offers generative design as a feature. They vary in specialities and accessibility. nTopology, Optistruct, Tosca, Truform and Fusion360 are just a few of them, specializing in everything from fluid dynamics to vibration analysis. We also looked into Grasshopper. It is a node based coding tool to the CAD program, Rhinoceros 3D.

The generative design part of all the tools mentioned above are all based on analysis driven optimizers. The biggest difference lies in Grasshopper, which compared to the others, is more comparable to coding your own tool.

Tools we decided to use

Grasshopper

Of all the similar generative tools, Fusion360 was the one immediately available to us and the most substantial in use for generative design. Grasshopper was included with Rhino and also another available program. We selected these two as our main tools to explore.

https://www.zaha-hadid.com/architecture/heydar-aliyev-centre/

Fusion360

Fusion's generative design tool is often used by engineers and Grasshopper is mainly used by artists and Architects. By exploring these two we would cover a big field.

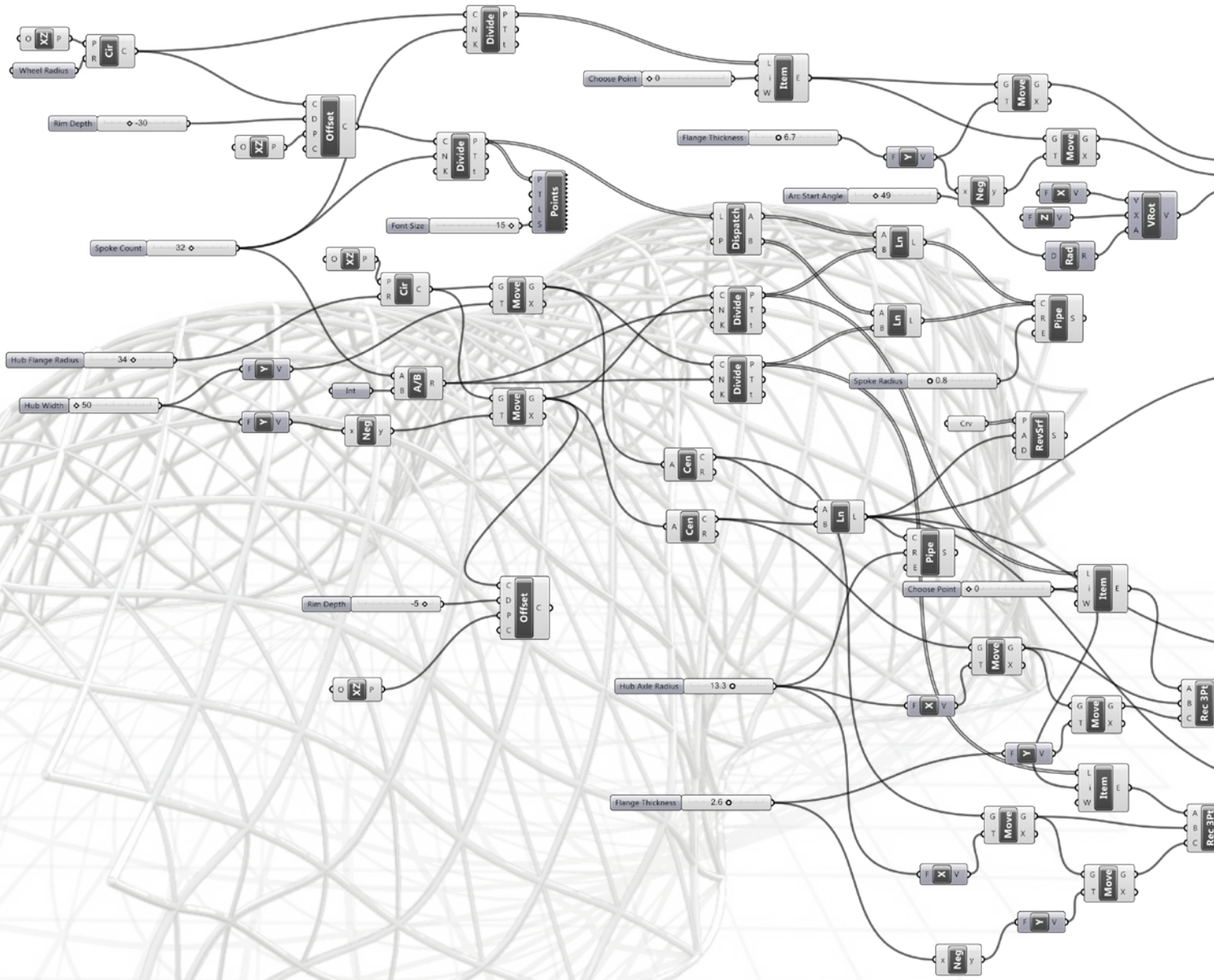
https://www.dezeen.com/2016/11/04/unyq-align-fashionable-3d-printed-back-brace-replaces-current-chunky-designs/

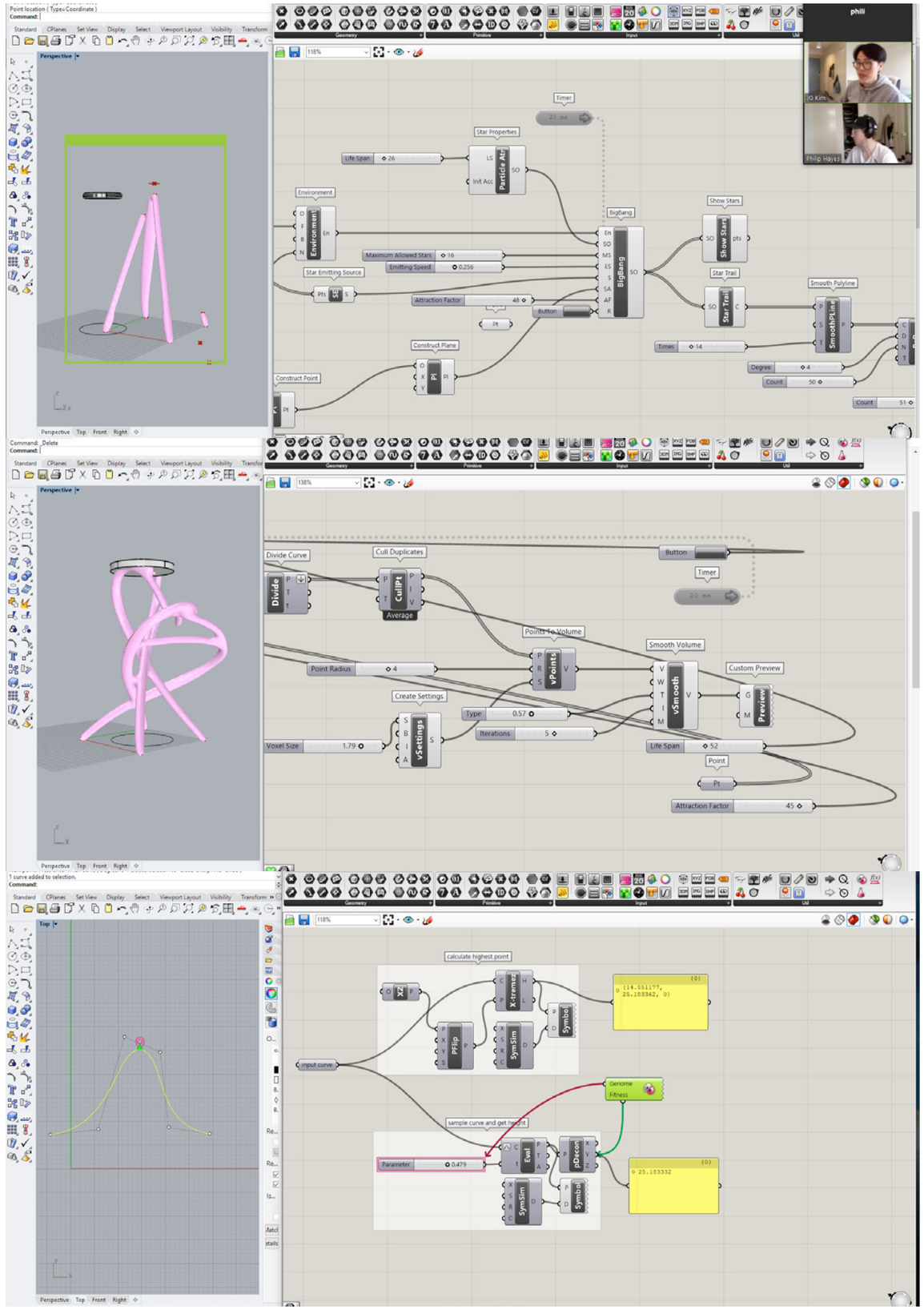
2.
EXPLORING THE TOOLS

Grasshopper

What is the grasshopper?

Grasshopper is an add-on in Rhinoceros 3D which is a well-known CAD program developed by Robert McNeel & Associates. Grasshopper is essential when discussing generative design, as it is widely used in architecture and art. Algorithms are created by dragging nodes onto a canvas and connecting them to other nodes. These algorithms allow for advanced control over 3D-space in Rhino, and are often used for generative, numerical, audio/visual, and haptic applications.





Exploration

We explored Grasshopper by making algorithms based on different add-ons; Galapagos, Quela and Stella 3D. With these we tried to look at different ways it could help us develop furniture.

Quela and Stella 3D

The most successful tests we did came from Stella 3D (picture on next page), it was the easiest to control and got the closest to resemble furniture. We made particle swarms with adjustable velocities and directions, then attracted them through gravity fields in 3D space. We could then give the particles trails that we could make in to sweeps and this would be seen as the legs on the furniture.

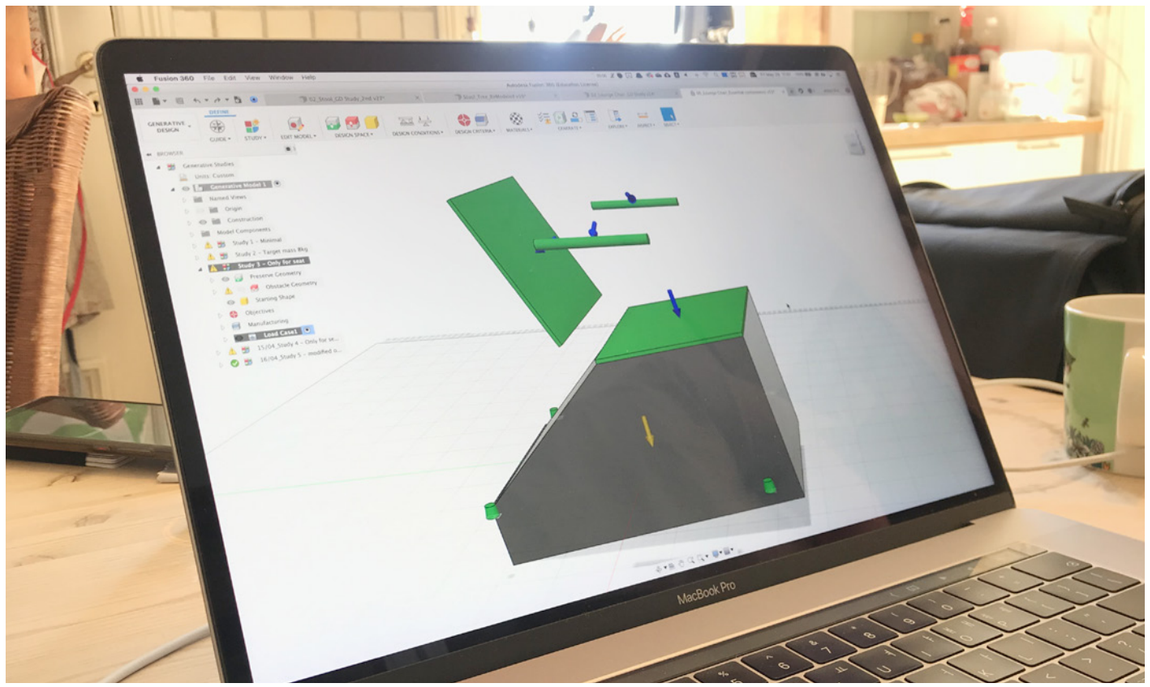
Findings

The Grasshopper tool demanded too much specialized knowledge and we did not have the time available to require the necessary skills. It also did not directly work like generative design. The Stella 3D tests we did, relied on a randomized algorithm that we tried to make generative, but the restrictions caused by Covid-19 forced us to change our focus.

Fusion360

What is the Fusion360?

Fusion 360 is a CAD program from Autodesk. This program supports almost all the features that the industrial design field needs including general 3d modeling, freeform modeling, manufacture, render and even simulation. At the turn of this year Autodesk added the generative design feature in Fusion360 and it became a perfect package for industrial design assignments.

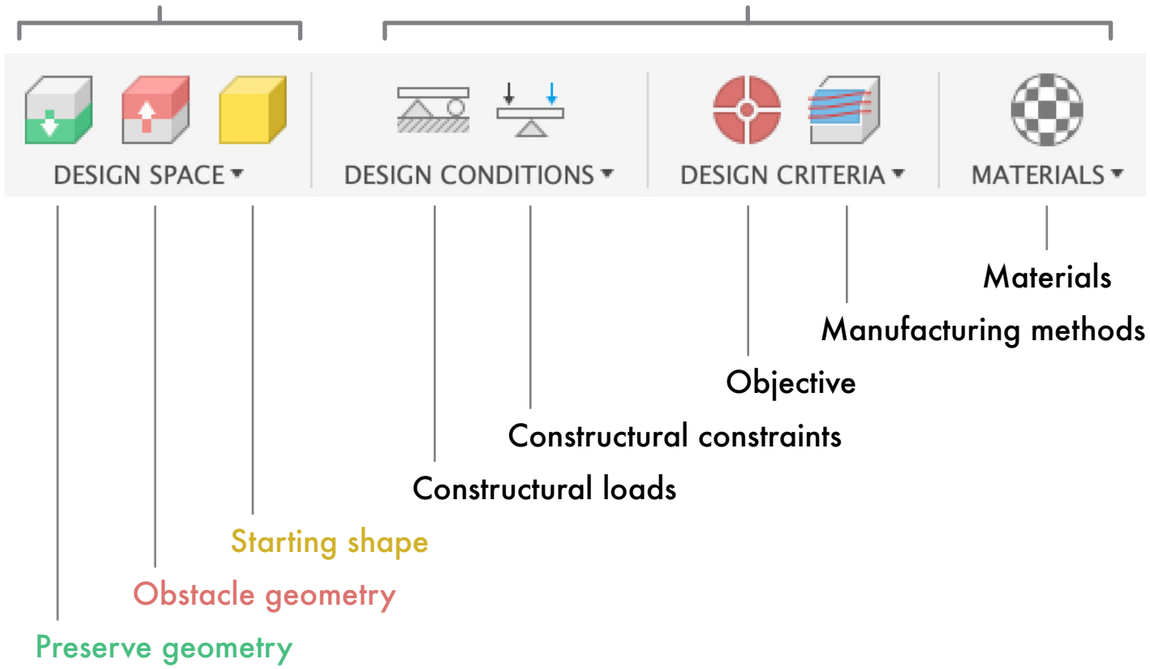


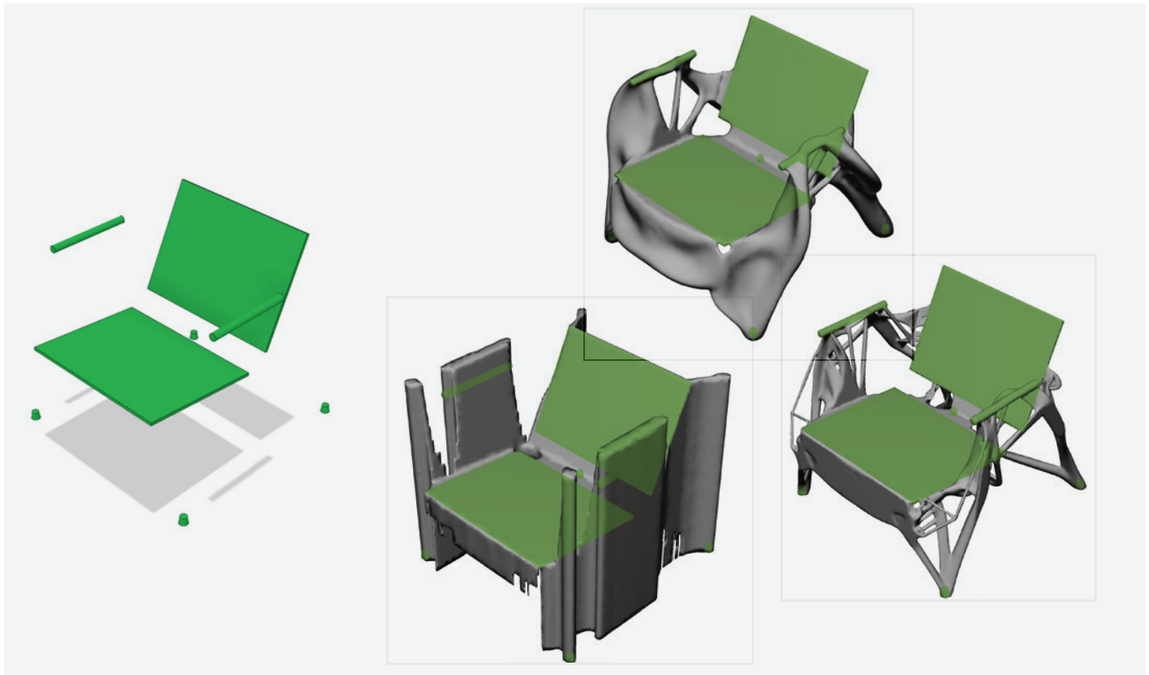
Inputs in generative design

There are a multitude of different inputs you can enter. Designers can apply their intention into the design of the generative design study.

Commands that allow designers to directly intervene in form creation

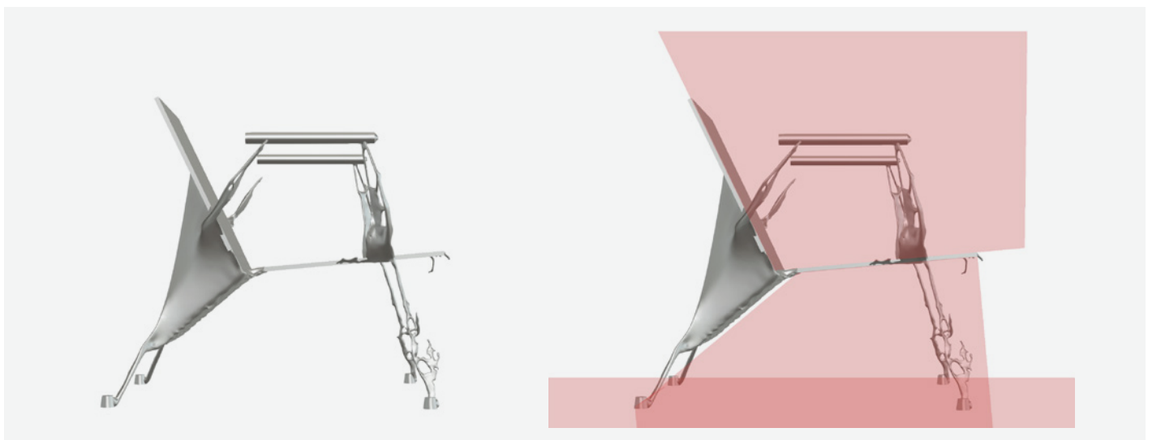
Commands that allow designers to indirectly intervene in form creation. Even though designers determine values in these commands, the predetermined algorithm control the form creation.





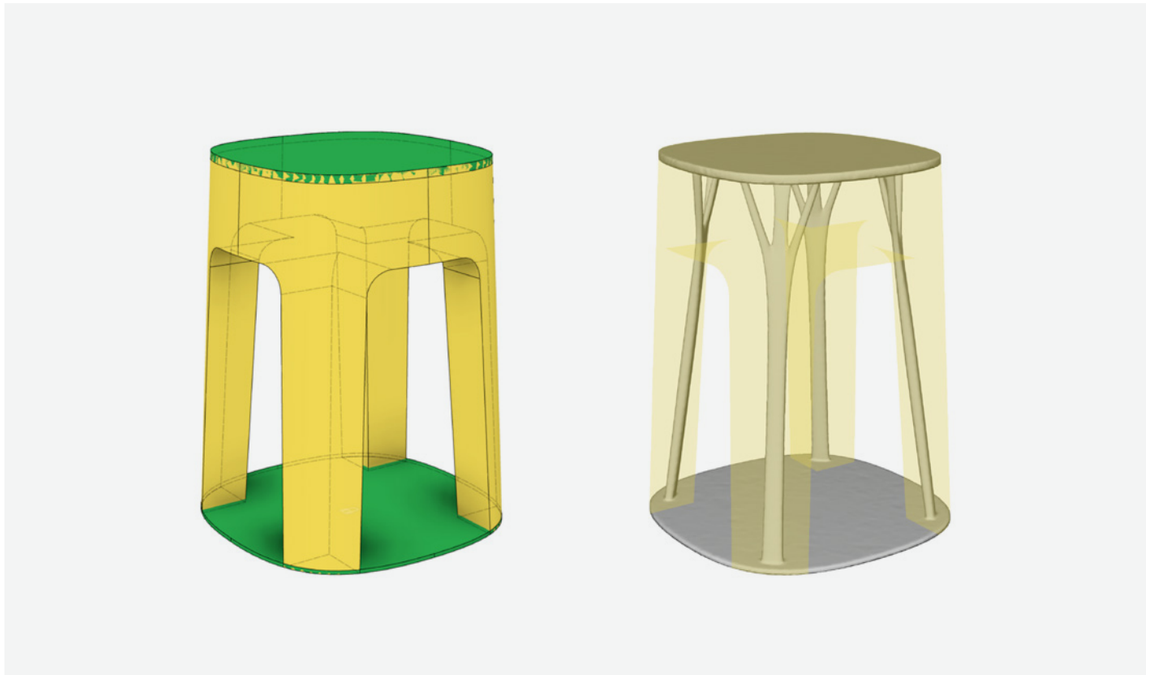
- Preserve geometry

This feature lets you preserve the components that are required for your final shape. In other words, you need to select all the components of your model that must be incorporated into the final design to complete its requirements. In our study our preserved geometries could be the seat and where the legs touch the floor, “the feet”.



- Obstacle geometry

The obstacle geometry feature is used to define any areas or space where the generated designs cannot take up space. Fusion360 will never generate any object in these marked areas.



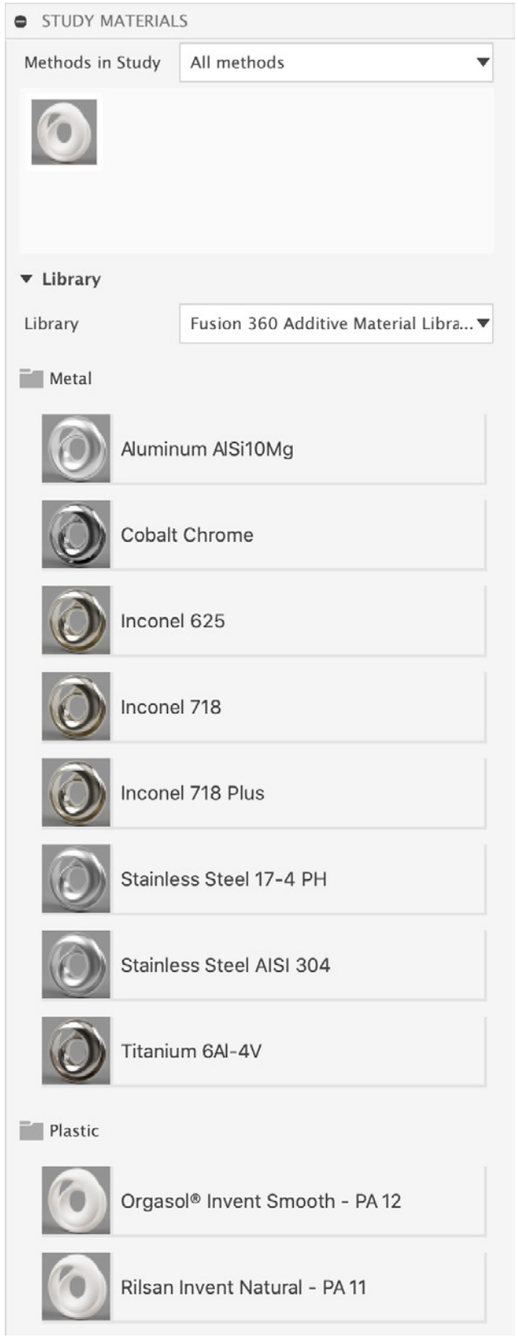
- Starting Shape

This feature lets you define a body that should be used as a starting point for all of the generated designs. The machine starts finding the most optimized form considering all the inputs within the starting shape geometry instead of whole possible area. Sometimes It can also be ignored by the characteristics of manufacturing methods.

These three inputs are the inputs that directly engage with your final model. Some other important inputs to apply are, structural constraints, Loads and manufacturing methods.

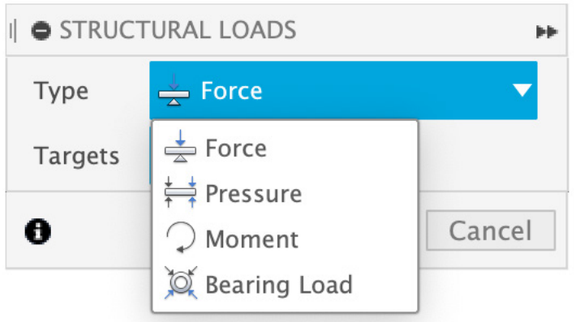
Materials

There are 7 materials available at this moment. There was no significant difference in shape between materials tested.



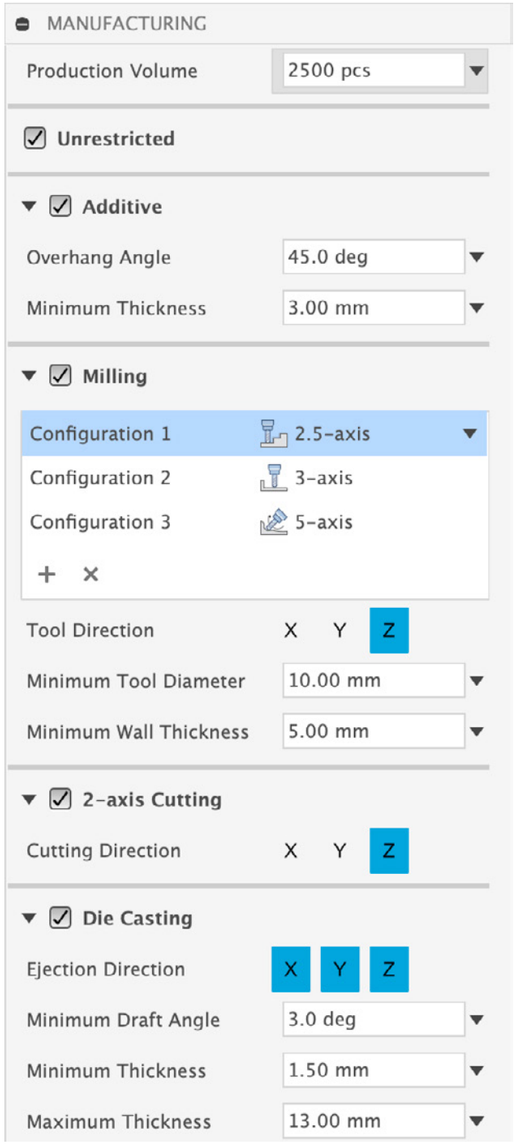
Loads

After defining the constraints we will need to define the structural loads, the forces that need to be factored into our design solutions.



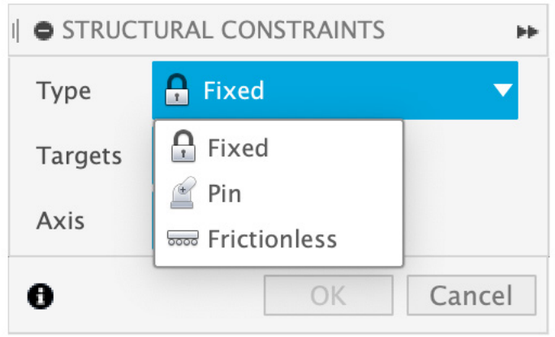
Manufacturing methods

Manufacturing methods have a bigger impact compared to other inputs such as materials and loads.



Structural constraints.

Constraints will help the program to know which parts of the object can not be moved. Defining these will make the generated outcomes a more realistic solution.



Exploration

There are several decisions for the user to make to run the generative design study. Each decision has a different feature and it can have a huge impact on the final result. Even if Fusion360 generates the final form with its algorithm, designers should be aware of their inputs and decisions to get the right outcomes.

Outcomes

These are the results of the generative design study we conducted to produce chairs. From our design point of view, we would not regard it as a high-quality design. But we were impressed by the ability of Fusion360 to produce a vast variety of styles in a relatively short time. These new shapes were inspiring and became a starting point for us to continue our design work.

Mapping outcomes

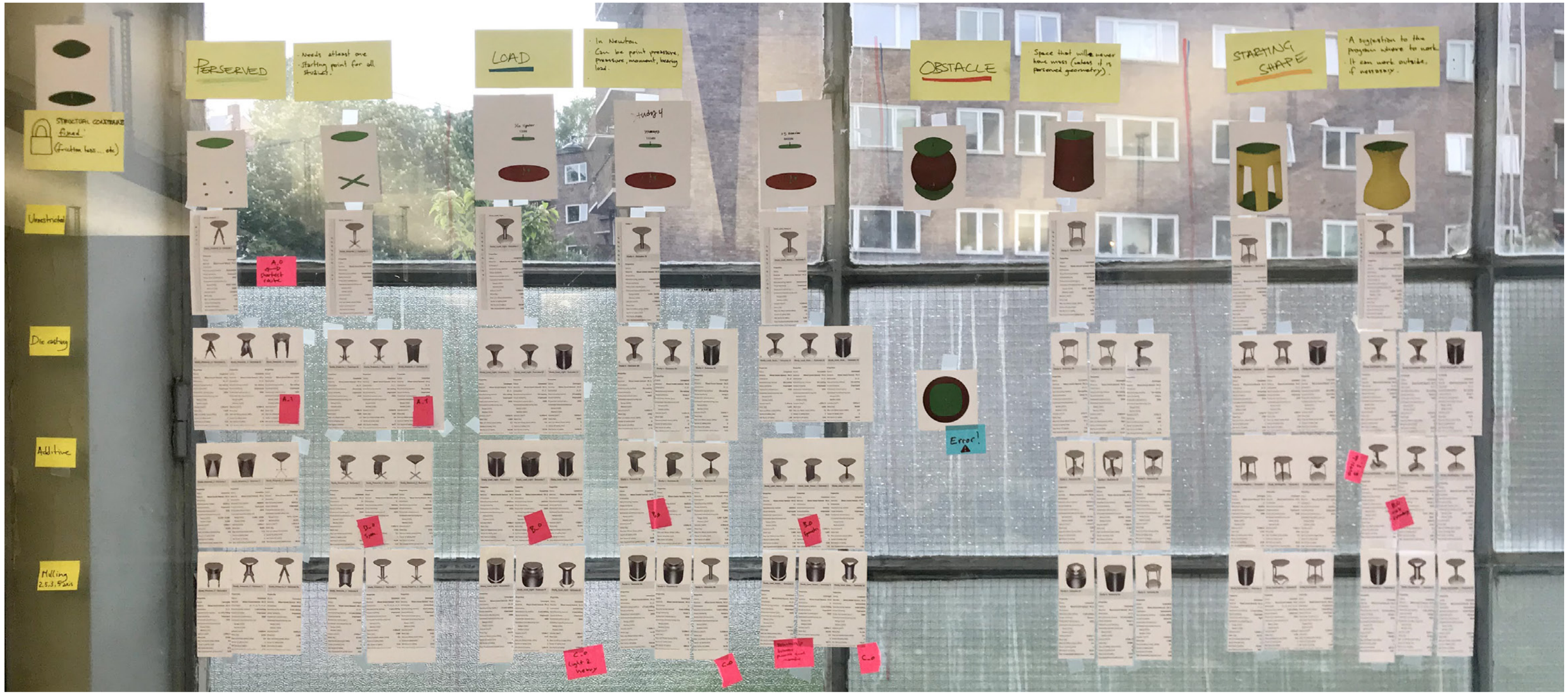
We listed and compared the results from the first study. Through this mapping, we were able to grasp the hidden characteristics of the tool in the relationship between each outcome. And we saw the relevance they would have from the designer's perspective.

Findings

- Sometimes it produces some outcomes that don't make sense.
- The manufacturing method has a great influence on the shape.
- HAPPY ACCIDENT!! Sometimes mistakes produce interesting results.
- Final outcomes are not symmetrical, even though all conditions are symmetrical.
- Material, itself, does not have a huge impact on the shape.
- The direction and angle of the manufacturing process greatly influences the shape.

3. DESIGNING STOOLS

2nd Exploration



The first generative design study allowed us to attain a deeper understanding of the tool, but there were still some unanswered questions. How much would the weight and direction of loads affect the form? How much influence does the 'Starting shape' have on form creation? Why do we face failure cases? Why do studies with similar conditions produce completely different results?

To solve these questions, we needed more controlled studies. In order to understand the characteristics of the tool itself more clearly, we thought that a simpler form could be more advantageous, so we changed the subject of the study from the lounge chair to a stool.
Based on the above, we started our 2nd exploration of the tool.

Findings

Through this 2nd phase, we could see how certain commands affect the form creation.
It was possible to know which commands had a great influence on the shaping form, and the relationship between the commands was also more clearly understood.

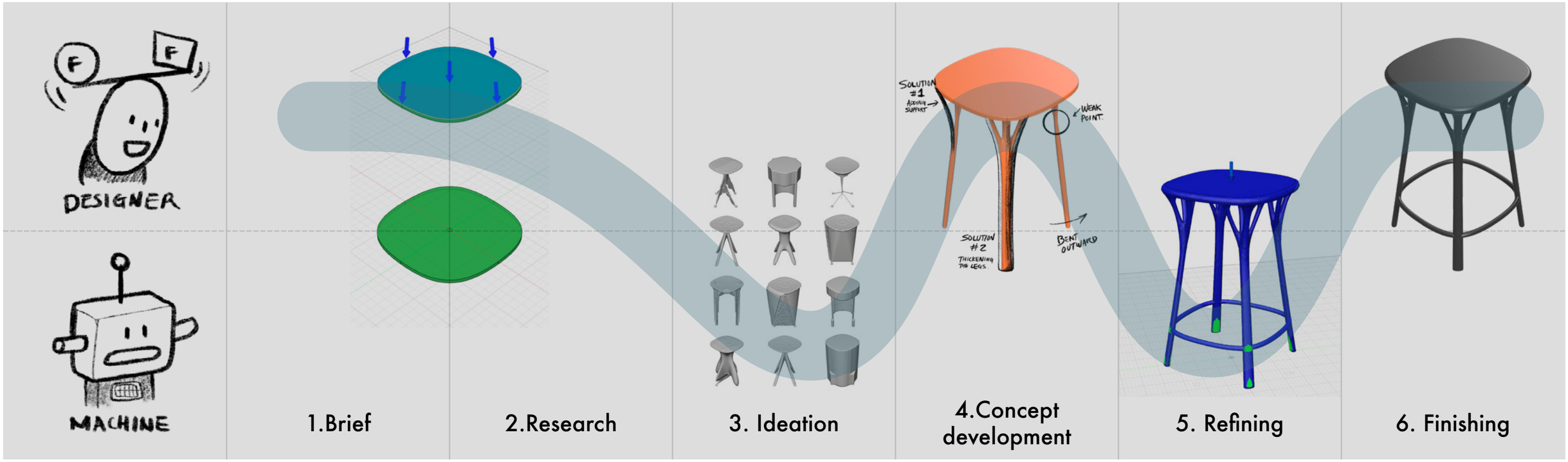
Preserve and Obstacle geometry commands were the most direct way to influence the shape. Starting shape acted as a boundary or playground for the machine to generate form, rather than suggesting the appearance which the designer wants to achieve at the end of the iteration.
(Picture: 2 different outcomes which look similar)

We found that manufacturing methods are one of the biggest factors that shape the form from a previous study. On top of that, we were able to see what determines the characteristics of the manufacturing methods. Manufacturing instruments' access angle and the direction of production define the aesthetic characteristic of each manufacturing method.
(Picture)

These helped us a lot in dealing with the tools more correctly and intentionally.

Workflow

with generative design



This is the workflow of the design process with generative design tools. We divided it into 6 stages from brief to prototype. After the design practice, we were able to figure out who performs better at each stage in the design process

1.Brief / 2.Research

In this the step one decides what to make and the purpose of it. The designer converts the information obtained through the brief and research into a program compatible with existing software (for the generative design program)

3.Ideation

In the ideation stage, the designer tries to derive as many design ideas as possible by using many different methods like for example thumbnail drawing. Unlike human designers affected by various practical constraints or personal biases, the generative design program that we use will generate optimal results based on it's genetic algorithms. This is the main reason we use the generative design tools.

4.Concept development

Among the many results obtained through the study of generative design, the designer can select and develop the results that suits his or her purpose. It is up to the designer how many changes to make at this stage. The designer can create new designs inspired by a given result, or use a given design as it is.

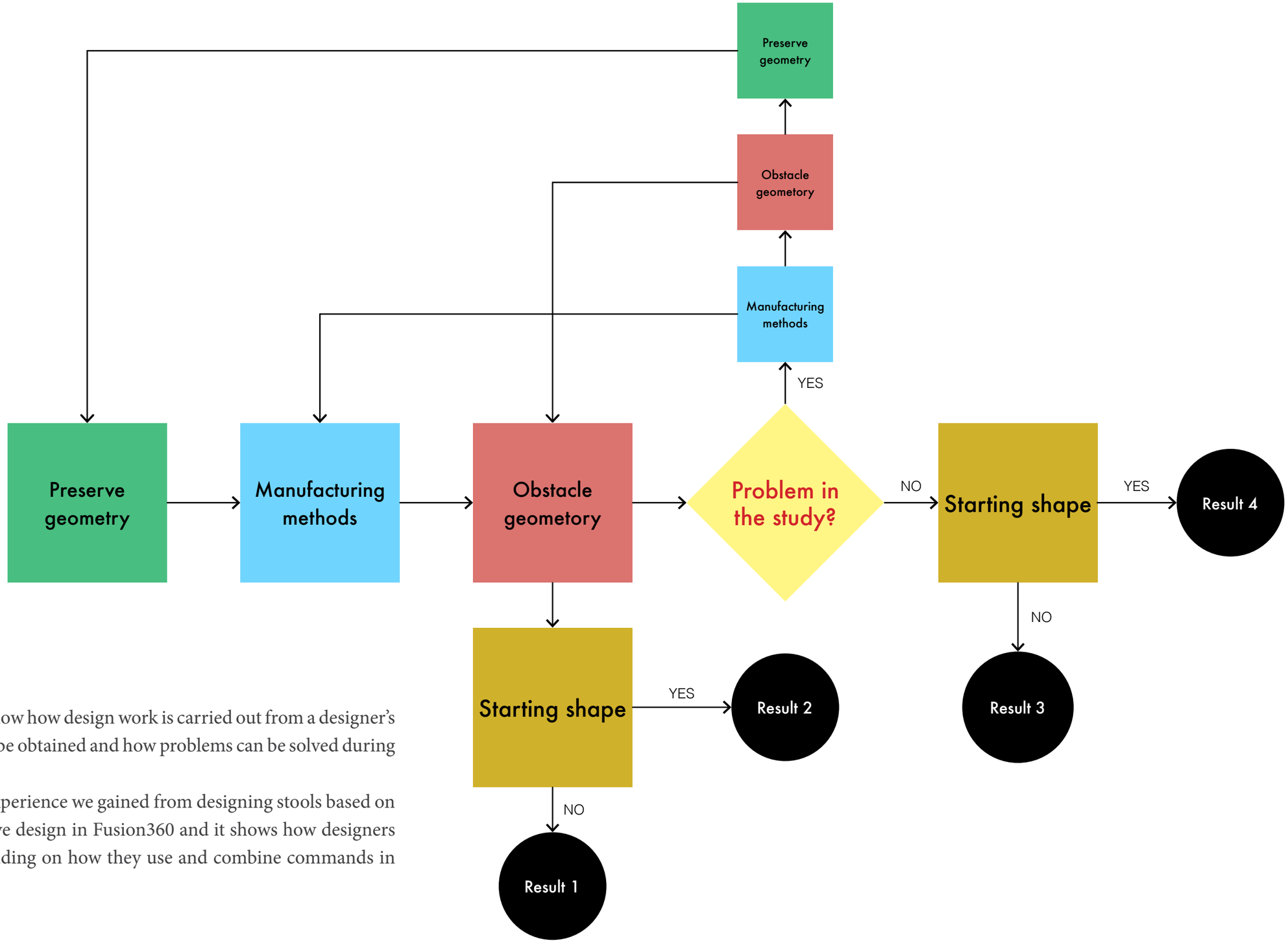
5.Refining

You can get help from the tool once again at this stage. Through the Concept Development step, you can ask the machine again to obtain new results and conduct structural feasibility tests.

6.Finishing

After these steps, the designer has the final product in hand.

Flowchart



This flowchart is intended to show how design work is carried out from a designer's point of view, what results can be obtained and how problems can be solved during the process.
The flowchart is built on the experience we gained from designing stools based on the basic interface of generative design in Fusion360 and it shows how designers can get different results depending on how they use and combine commands in the tool.

Design story 1

Lina

Photo by Andrea Piacquadio from Pexels

Name: Line
Profession: Industrial designer who has engineering degree
personality: She likes math.

Design story 1

Design brief

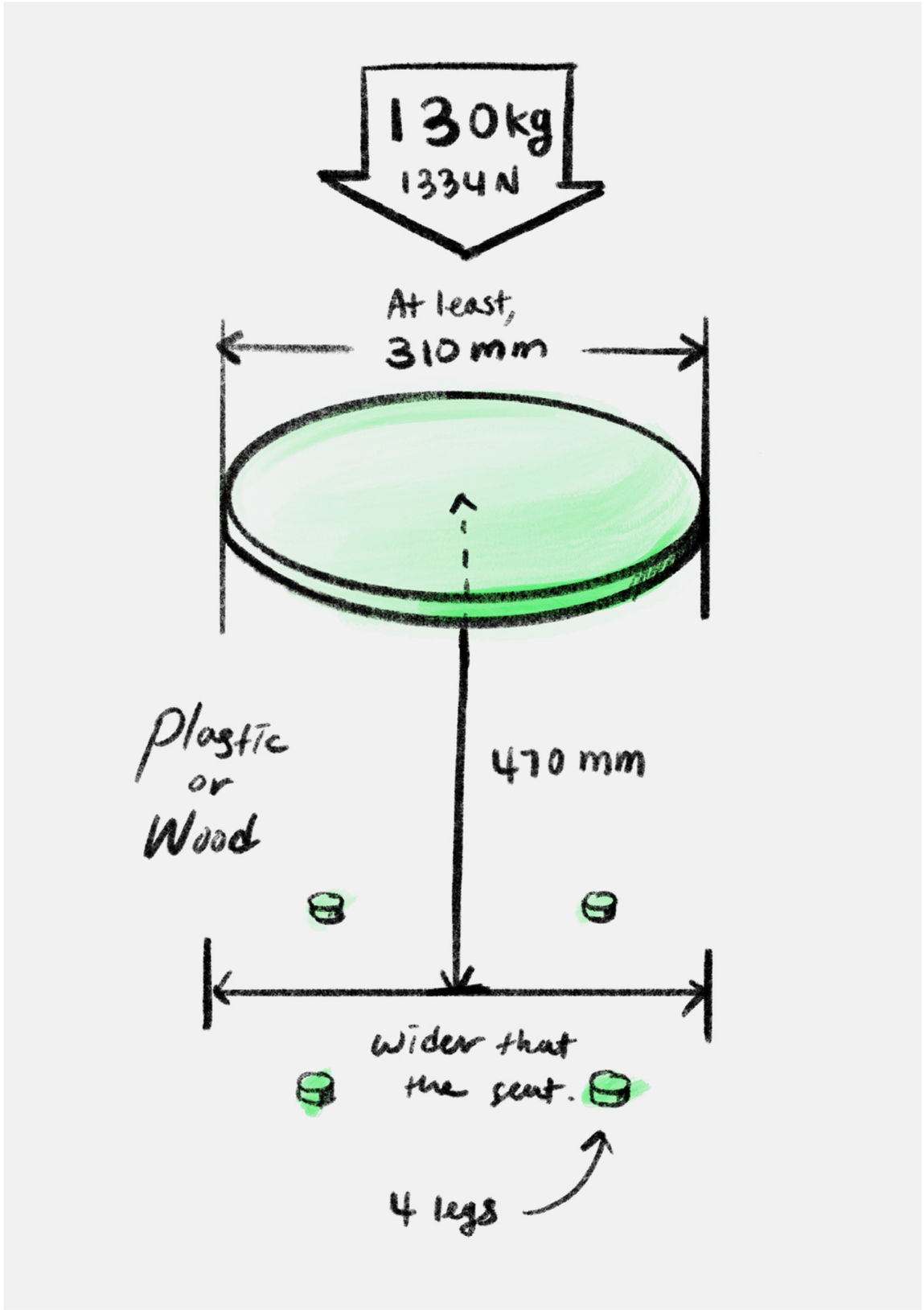
Here is a designer, Line. She is about to design seating furniture with a new method, generative design in Fusion360. She just got to know this program and thought this tool suitable for the project.

The design project given to her was a stool to be placed in the Natural History Museum in Oslo. The client asked for a stool that would echo shapes found in nature. The width of the seat should be around 310mm. It also should be able to bear a weight of 130 kg with a safety factor of 2, and the height should be 470mm. They thought four legs would be necessary to make the stool stable and secure to be seated. This was the information she got from the client.
In this project, the client had ordered organic shapes in the stool, and she decided to get help from the generative design tool. She had just seen some products in a design magazine produced with the help of generative design. She remembered that the shapes of those products resembled organic shapes from nature. Since this nature-friendly style was far from her personal style, she decided to try the generative design tool to start off the project.

3D printed steel knot developed by Bayu Prayudhi, TU Delft Architectural Engineering graduate
https://facadeworld.com/2016/07/08/3f3dnext-generation-printed-steel-knots/

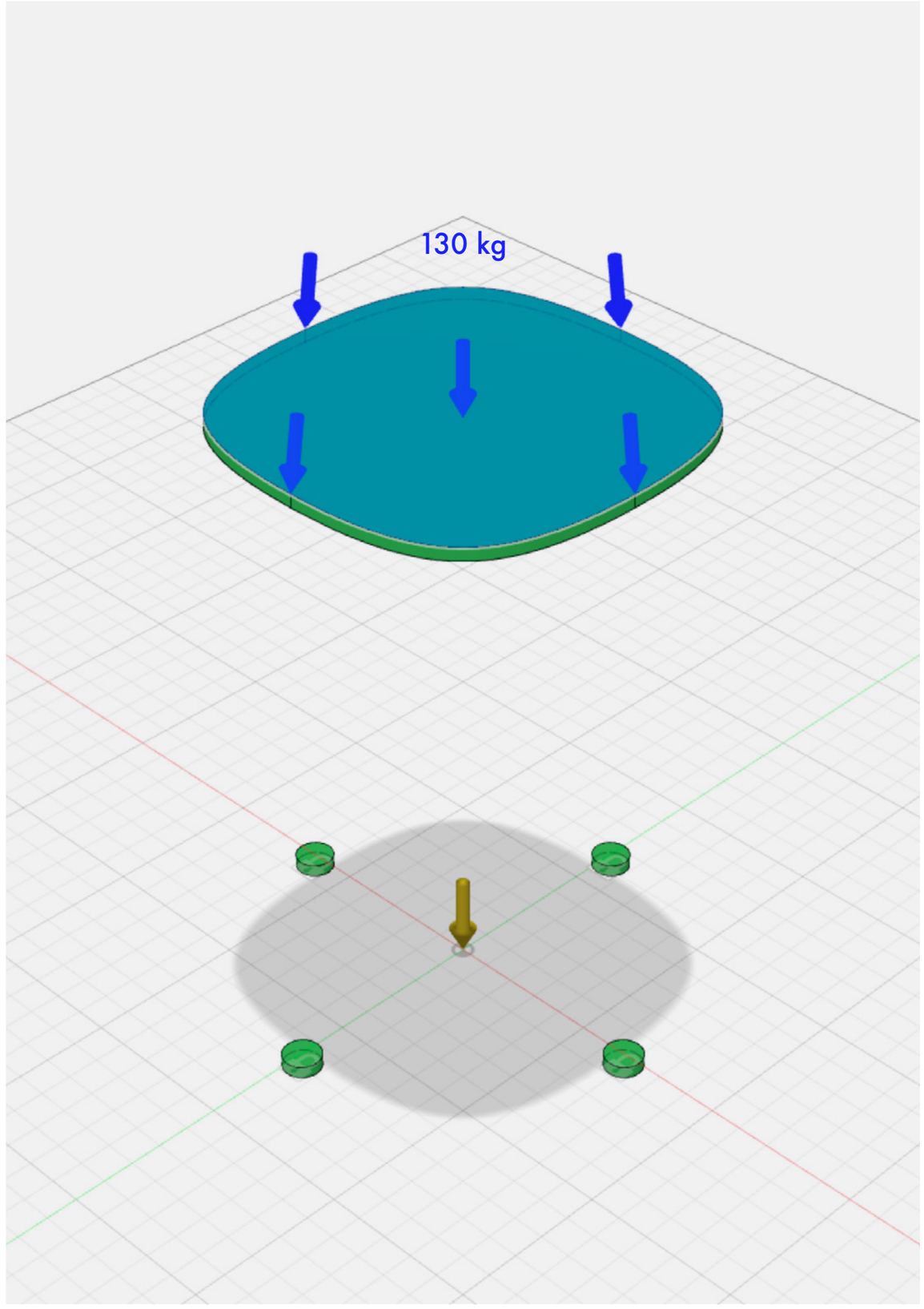
Design brief

Line completed a brief sketch based on the customers requirements. All the preparations for starting the design process were done. What remained for Line was to deliver these requirements to the tool.



Through several commands in the tool, Line delivered the requirements for the stool to Fusion360. She set the shape and height of the seat and created objects that would act as feet for the stool to match the 'Preserve geometry'. The machine would start generating forms from these 'Preserve geometries'. Next she delivered the information on load force to the tool through 'Design conditions' so that the chair could have a reliable structure that would withstand 130 kg.

Line could leave the initial design work for Fusion360 and leave for lunch.

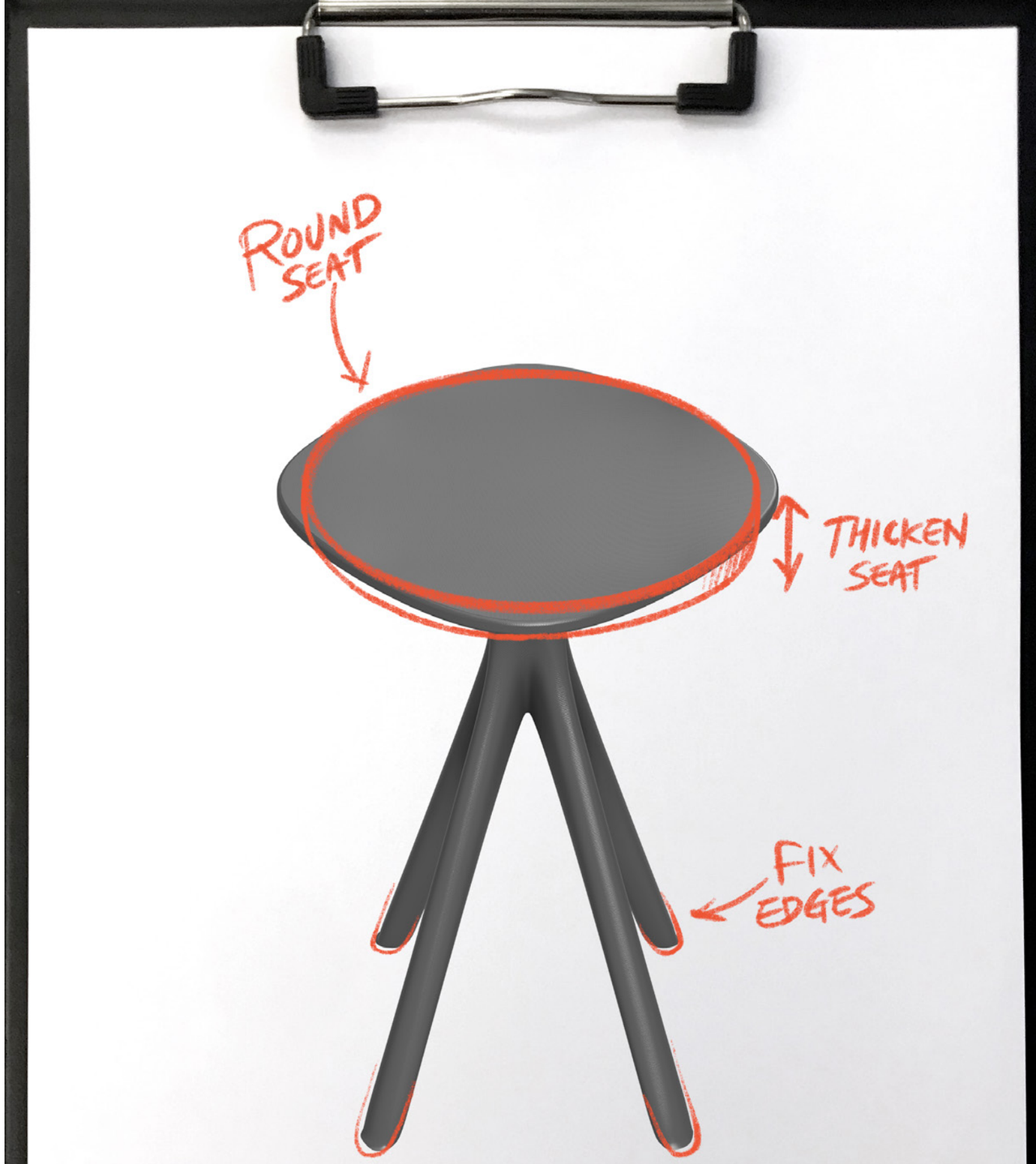


Outcomes

After lunch Line took a close look at the various stools proposed by Fusion360. She had thought the generative design tool only creates organic shapes, but when she checked on the results, she discovered her mistake. The products done by generative design were not only organic shapes. Each design result had its own characteristics, which was determined by each manufacturing method.

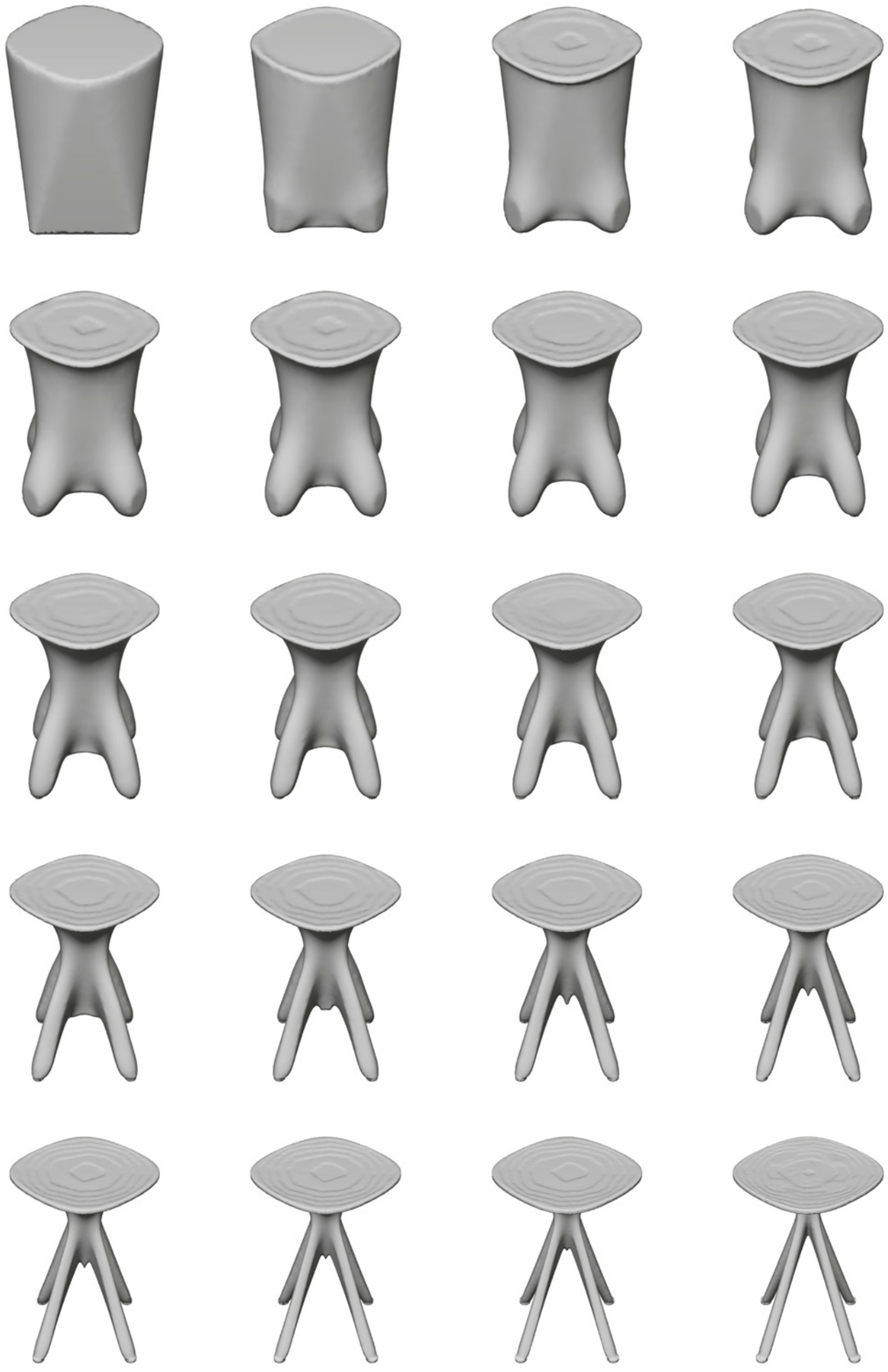
She chose one stool that was particularly standing out in her point of view among all the results. The shape of this particular stool had resemblance with organic shape and matched the initial design. The form supporting the stool's seat was particularly interesting. Irregular, but in harmony which we can easily find in nature.

That special aesthetics caught her attention. Line looked at what she could do to improve the design to mature. She would try to keep the special feeling that came from the generative design study as much as possible.
Line was quite happy with the one she had chosen among all the stools. However, there were still small things that had to be corrected.
Line looked at what she could do to improve the design maturity keeping the feeling that came from the generative design study.



Developing

Initially, the generative design study started with a square shape with rounded corners, but considering the given shape of the legs, Line decided to change the seat from the rounded square to a perfect circle. Because she thought the round seat would fit the legs better. She also gave some minor changes by fixing some uneven surfaces.



Interation process

Unlike human-made designs, designs that are completed with generative designs are not symmetrical. Sometimes very uneven results appear depending on the manufacturing method used, so the designer's help is required in the final step.

Through the generative design tool, it was possible for Line to achieve the goal of obtaining an organic shape. In addition, she was able to solve her misunderstanding that generative design tools would only generate organic shapes.

Design story 2

Christopher

Photo by Andrea Piacquadio from Pexels

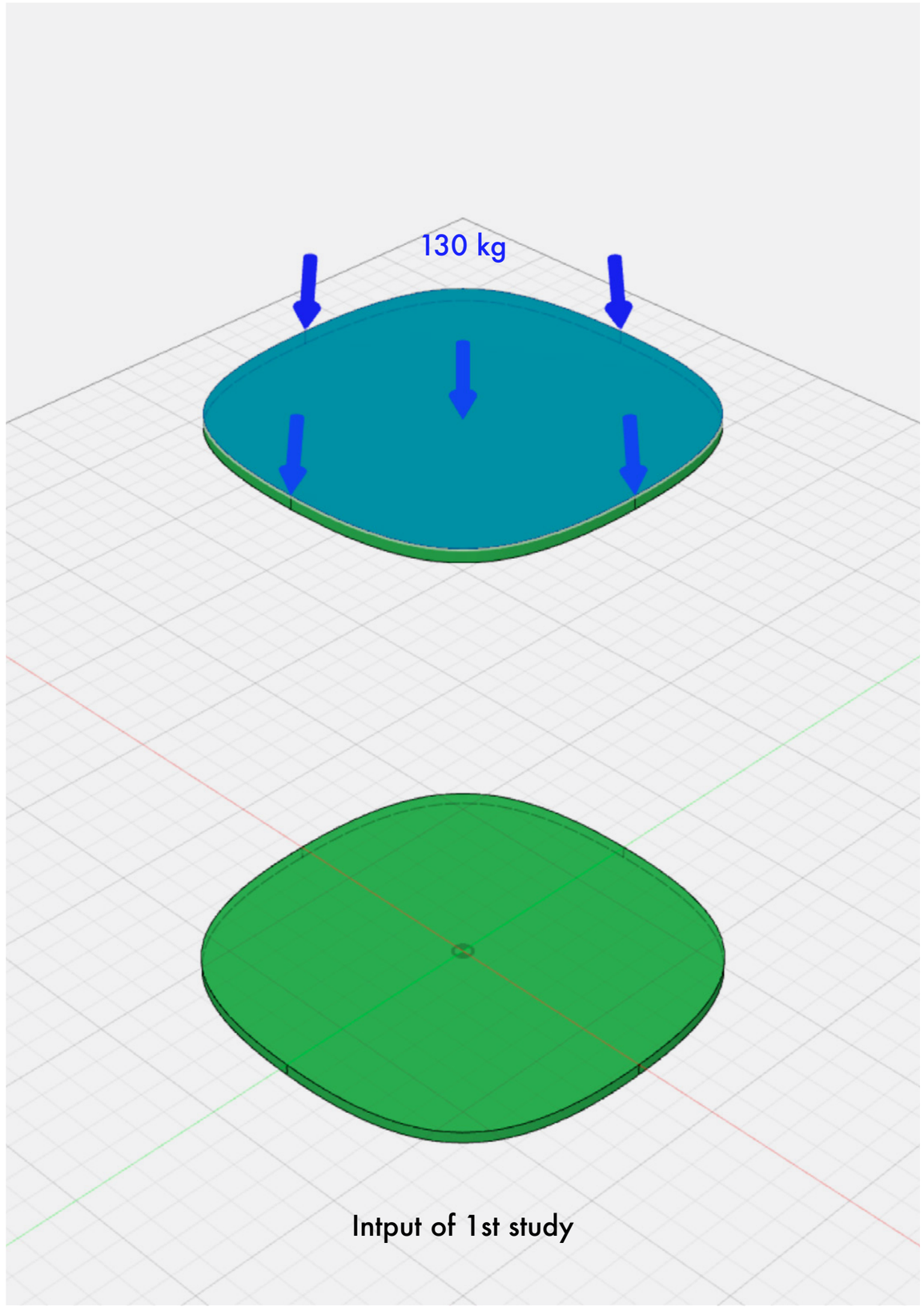
Name: Christopher
Profession: 10-year designer running own design studio
personality: Loves japanese culture for minimal and emptiness.
Likes combining Nordic and Asian culture to create special feelings.

Design story 2

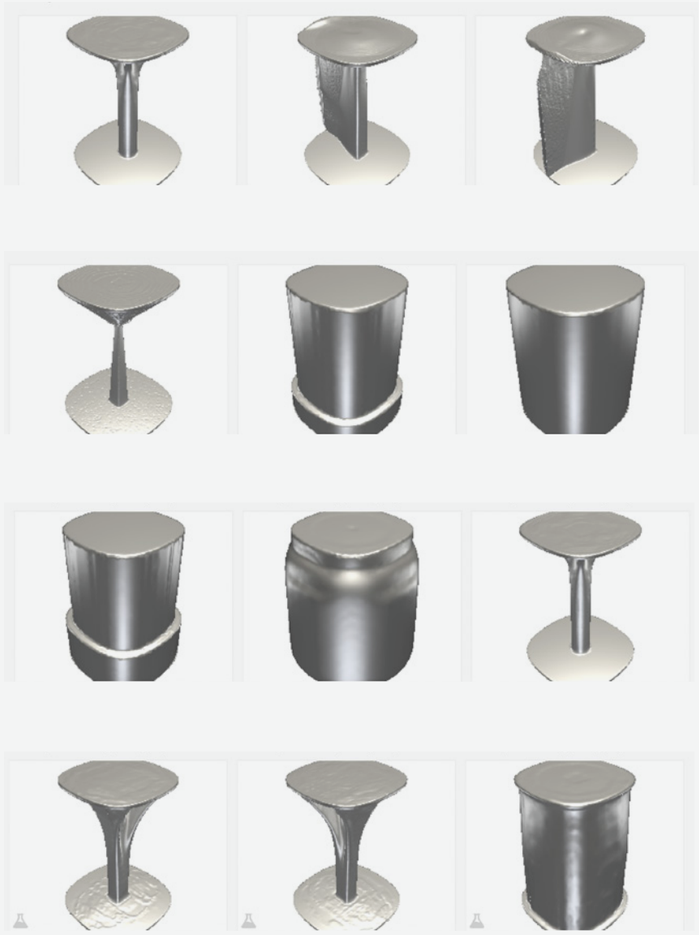
Design brief

Christoffer has been a designer for 10 years. In this period he has had many assignments and has developed his own style. At this stage he was feeling a bit inhibited by his well established design style and wanted to advance his style further. To do so, he needed a new stimulus. He decided to use a new design tool called generative design in Fusion360 for his new project. He had heard that this tool was more active than other design tools and even seemed intuitive. He believed having this tool as a companion, he could make a positive change in his design.

In the first generative design study, he tried to give the machine more freedom expecting more creative outcomes by giving a wide preserve geometry on the ground. This would give a bigger playground for generative design.



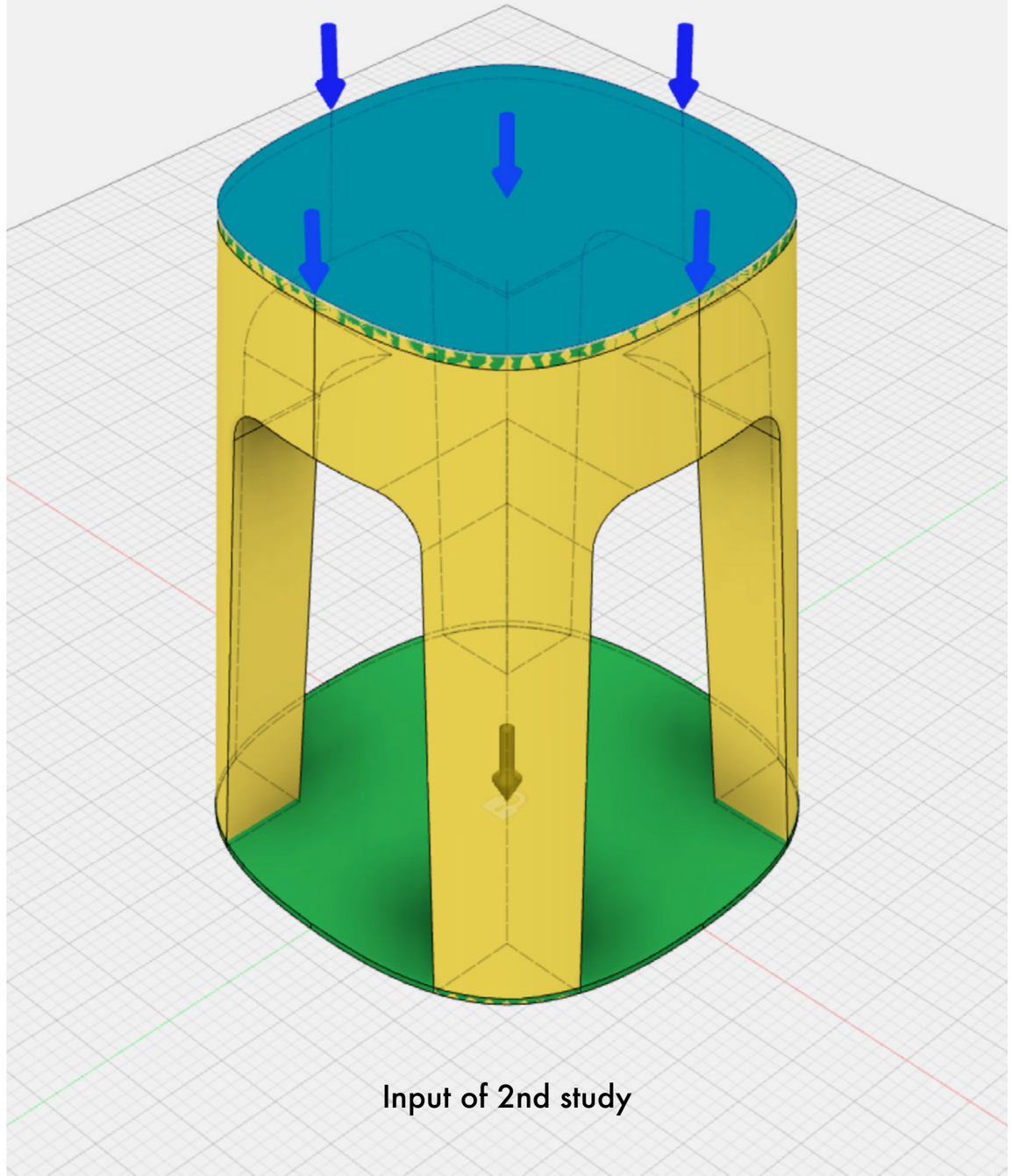
Intput of 1st study



Outcomes of 1st study

The first result from giving Fusion360 a lot of freedom to generate form was quite interesting, but he could not find a satisfactory result. Was it because this tool could not be as creative as we, humans, are? The tool would only try to find the most efficient way rather than the creative way. From this study, he learned that this tool was not a designer, but rather an engineer who was an expert at finding the optimal solutions. Therefore he had to play the role as a designer in this collaboration.

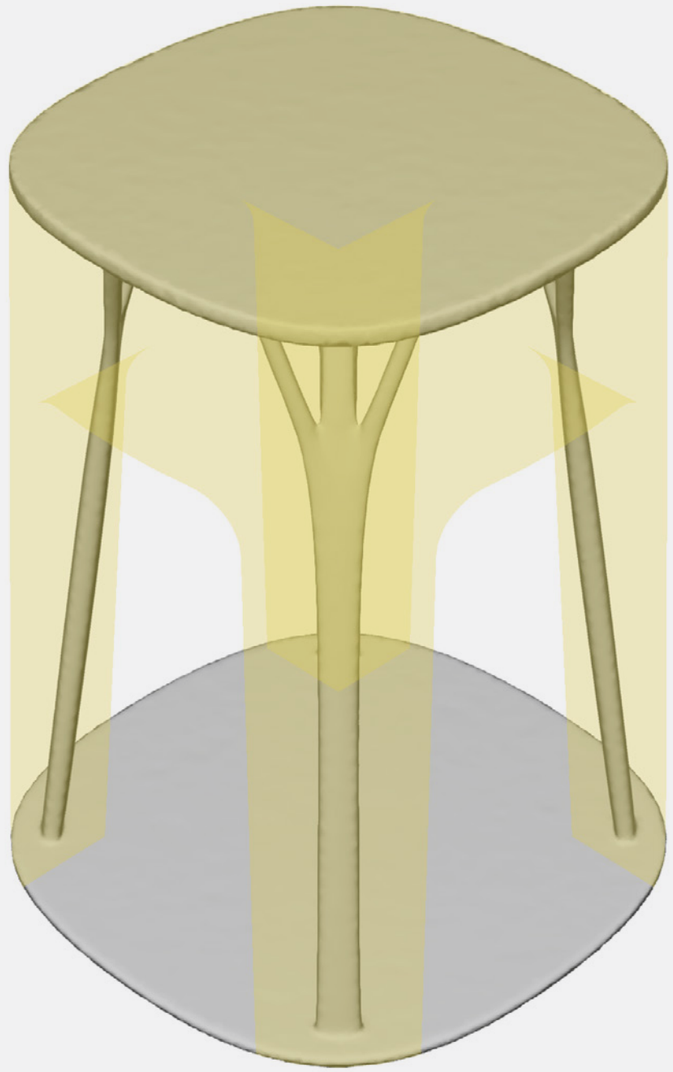
It was necessary to communicate more clearly with the tool about the design direction. He wanted to have a stool with four legs in the corners and in addition have structure that would support right under the seat onto the legs and get slimmer going down to the bottom. So he created a new form or starting shape that could initiate that design direction to the machine.



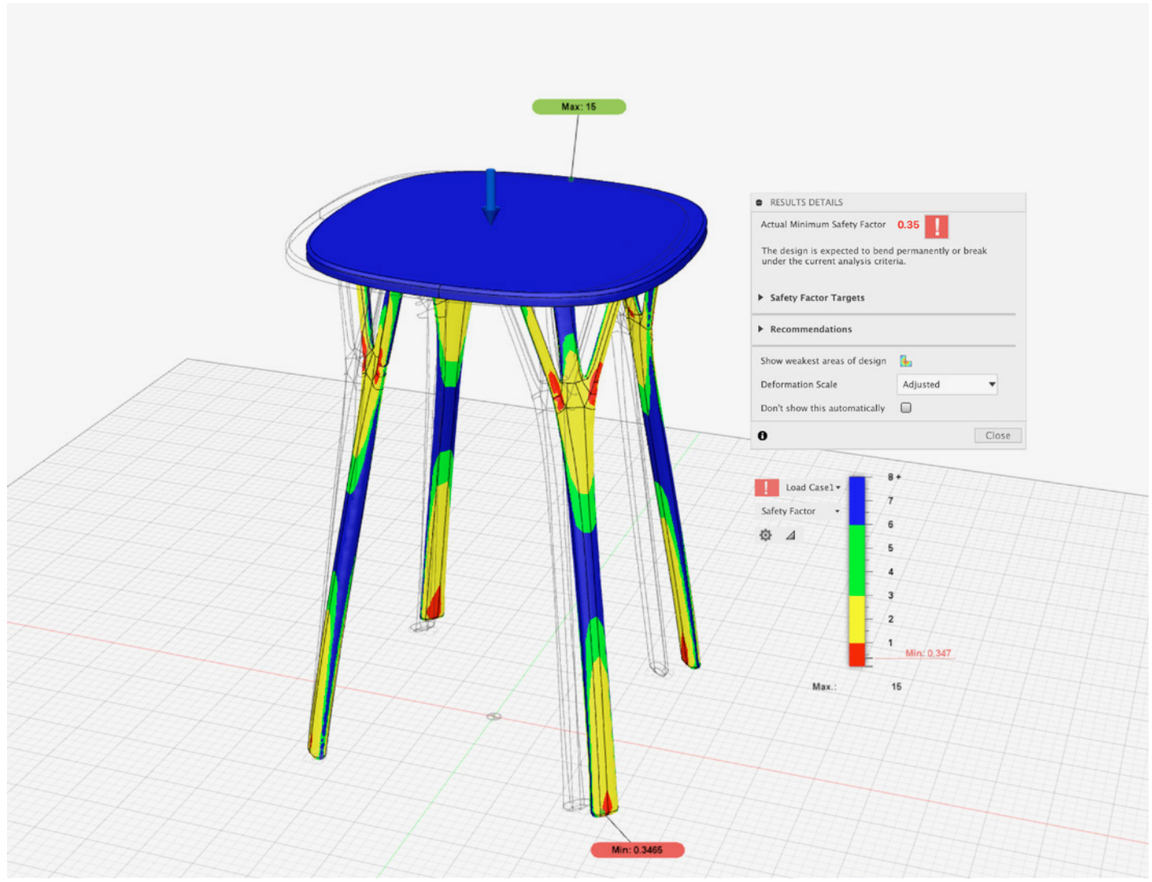
Input of 2nd study

Outcomes of 2st study

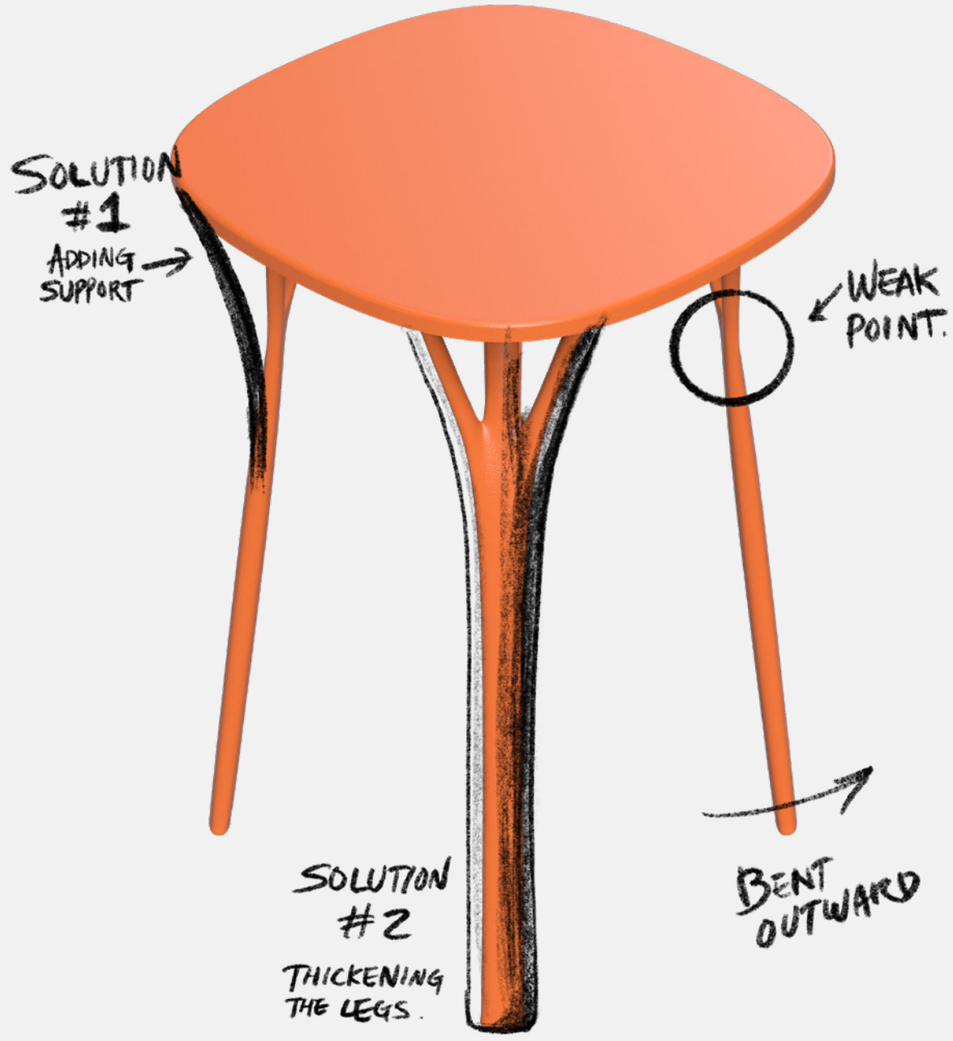
After some time, Christopher had a whole new set of results. The second study created stools unlike previous study by following his guideline.



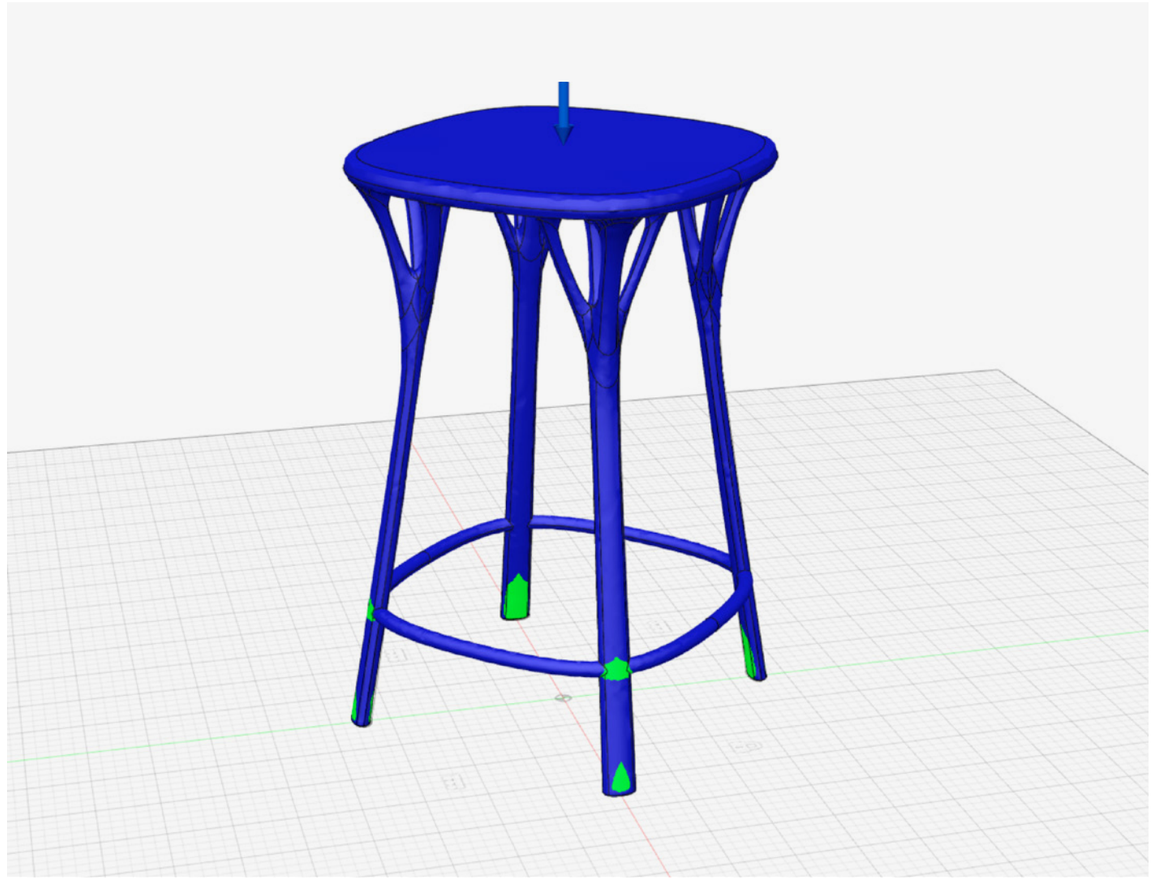
Among the proposed stools from Fusion360, he was able to find one stool that he initially envisioned and he decided to develop this one further.



But structural problems occurred when he removed the bottom object holding the four legs together. When he had set to give the algorithm a wider range of possibilities of form creation, the overall structure had changed. It caused the structural problem so the stool could not bear the human weight. To solve this problem, he conducted another generative design study once again with the flawed model. But he could not find any satisfactory result, so he decided to solve the problem himself.



He searched for a way to solve structural problems while maintaining the feelings of the current form.



In the end, he solved the problem by adding additional structure to hold the four legs together and finished his design work.

From this project, he found that this tool only finds the most optimal answer for a given condition. Form generation was only a natural phenomenon in the process of finding optimized structure within a given condition. Since there are no options for dealing with aesthetic values in the tool so far, he has found that the ‘Preserve/Obstacle geometries’ and ‘Starting shape’ must be properly used to obtain the desired answer.

5.
REFLECTION

Reflection

Corona

The situation caused by the Corna was most unfortunate for our project. The way we got immobilized overnight and not being able to meet in front of our pinboard to discuss brought the process to a standstill. We spent some time trying to adapt to this new situation and to pick up our previous drift. We struggled but could never get the same inspiring discussion as when we were in the same room. We missed the immediate communication being together as like minded people. Since we have been an international group with different mother tongues and culture, it has been challenging not having access to a common space. We have learned just how important being in the same room is! On the other hand it is very interesting to have different perspectives and culture.

Between general hindsight and Covid-19, we have some things we wished we could have done, but either did not have time to do so or we did not see it clearly enough.

After gaining a lot of knowledge and skills in generative design, we are well equipped to create future scenarios for how the world of industrial design could look ahead. By doing some more real world research on designers and companies, we could have made clear pictures of how a timeline from now and 10-20 years ahead could possibly look.

Our situation also demanded us to make more virtual products which made designing the final stools more tedious. It would have been great to explore what we could have made with other digital manufacturing methods rather than 3D-printing. It is also an important step for a designer to build in 3d space to get an understanding of function, scale and aesthetics.

We could also have dived deeper into the production methods and constraints of the tool. There is some room for playing around with production, like in 3d-printing for example: We could have explored how changing overhang angles and likewise would have affected the outcomes.

Fusion and other tools

Throughout our research we always got the impression we would get hundreds of results from each test, while in reality we actually just got one result from each test. The reason for this confusion was that we can test for 13 different manufacturing methods at the same time, which will give us 13 results. On top of that, we can add 7 different materials to each of these, which will result in close to a hundred outcomes (91 to be exact). Through our research we found that by eliminating some production methods and materials used in the tests, we instead ended up with closer to 10 outcomes per test instead of the previous 91.

We found that 2 axis cutting was too limiting for the program and often gave us the most basic shape imaginable from preserved geometry. If the seat would be round, the result would be a cylinder. Therefore we decided to cut it. We also saw that materials had little impact on the end results. No matter the production method, the results would be close to identical cross material choice. Of the 7 materials the generative design tool in fusion has available, we decided to only test one; Rilsan Polyamide 11.

The seven materials consist of super alloys like inconel and titanium, used in space and ruff maritime conditions. Using these have affected the look of our outcomes and often yield results that look far too fragile. We do not expect a stool to be made from titanium and this aspect we had to a certain degree ignored for our project. That is why we chose Rilsan, the weakest out of the seven materials, but would be the closest to a real world scenario and still robust enough for this purpose.

The models we have made in this project are all made by one material (PLA). This is a bioplastic that is recyclable and biodegradable. It is still expensive, but we can foresee a future where it will be cheaper and generative design can flourish in this material. It will hold a person under 100 kg, but is clearly weaker than the intended plastic, Rilsan pa11. which the tool based its simulations on.

The generative design tool in fusion is made primarily for engineering and therefore in lack of any direct control over the objects aesthetics. The aesthetic expression will still be in the hands of the designer. It does not mean that the program can not create products pleasing to the eye. It does base its simulations on our geometry and does give us some choice in production methods to use. Our option is to decide which manufacturing method we believe would produce the best result and do changes for appearance to the design if necessary.

Is fusion hard to learn? We would argue that it is rather simple and it wont take a person with prior CAD knowledge long to get results. To master it fully is a long process and we still have a way to go even after this diploma project.

Choices made throughout

We had to limit our tools explored throughout this project, we started quite wide with a lot of different tools but ended up choosing one.
The impression from our research gave us a preference for Fusion. In addition we had Grasshopper that was very interesting because of its dissimilarity from all the other programs. Do we regret not exploring Grasshopper more? The answer is no.

If we had dropped fusion and instead continued to explore grasshopper, we would have probably had a lot of knowledge on a much smaller area. Grasshopper is a very good program to create specific designs and specially in Architecture where they work on one building project at the time. In designing items like furniture the projects are smaller and more varied. If we coded a tool in Grasshopper to use on a chair, it would demand a huge effort to change for a stool when we would need to do the coding all over again.

We had to move away from the chair. It got too complicated to design in the tools when exploration was our mission. We changed for a stool to simplify the process and this decision solved our immediate problems. A simple seat and some way to connect the seat to the ground gave us a good resemblance of a stool and a better insight to Grasshopper and Fusion 360.

Our future as industrial designers

The potential of generative design tools is huge! It is incredibly exciting waiting on results from a test started the day before. We can only guess what the tool is going to give us granted, but we have become a lot better at guessing what it is going to give us.

It is definitely changing the way we are creative, we are no longer the sole creator of form, we are being augmented. We are headed for a future where the program is going to be advanced enough to answer our questions by giving us suggested designs.

But as the generative tool develops, it will help us achieve bigger things. It can go through thousands of simulations, and it is only getting faster. We believe this technology will have a massive impact on our world and is something we will have to watch out for and learn about to stay ahead.

In our near future it will be exciting to see how they add materials and production methods to the generative design tool. It could be really interesting to see them work on some older methods, like bending and laminating wood, maybe it will help us create new methods for shaping materials as well.

After learning of how the generative design tool works, it is hard to believe it will take our jobs. If we, as creatives, ever got replaced by a machine, we would have a lot bigger issues than losing our job.

Conclusion

This project has given us a deeper understanding of the tool and field around generative design and is hopefully going to aid us on our journey as industrial designers.

We started this project with naivety and scepticism towards generative design that now has vanished. We believe generative design will take a major place in industrial design in the future.

Our jobs are not in danger, but we have a need to change with the times as our tools are developing at an incredible speed, and the development is only speeding up.

We have learned a lot about structure and how important time management is. Communication is also one of the most important attributes for a designer and here we always have room to improve.

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Finidng Form

Exploring the potential of generative design tools

Arkitektur- og designhøgskolen i Oslo
The Oslo School of Architecture and Design