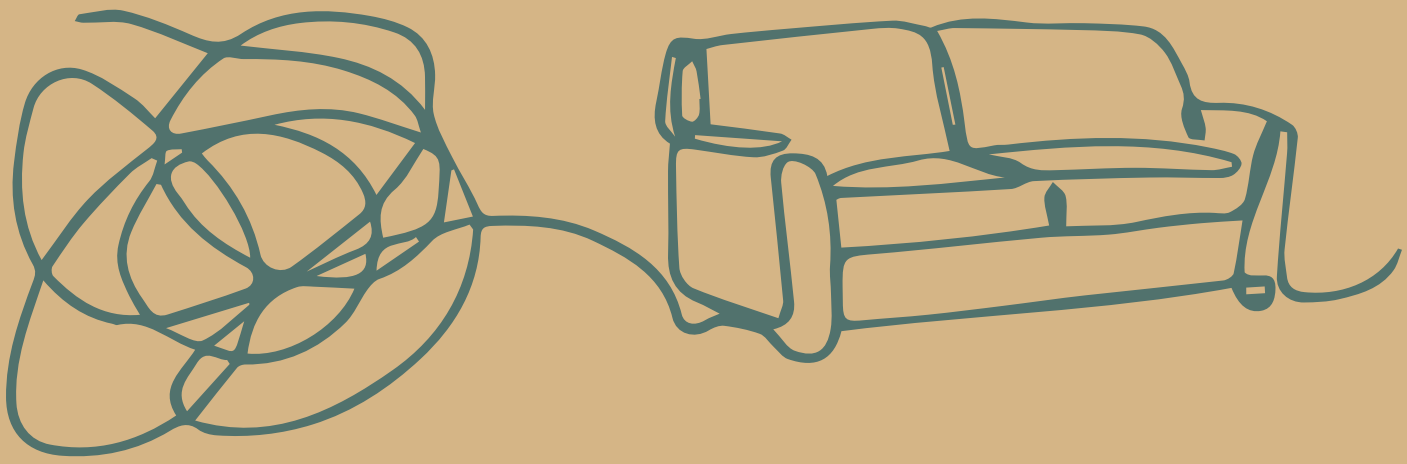
RE-FOAM

Material & design exploration for sustainable soft furniture



Kim Lund

Photo (1)

(1) https://9gag.com/gag/aOQ4yPD

WHY DO WE SIT & LIE?

EVERY DAY & EVERY NIGHT

ON PRODUCTS

CONTAINING POLYURETHAN, POLYESTER AND OIL

WHICH HAS A CRUEL MANUFACTURING PROCESS

WHICH CANNOT BE RECYCLED BUT ONLY DOWNCYCLED

AND

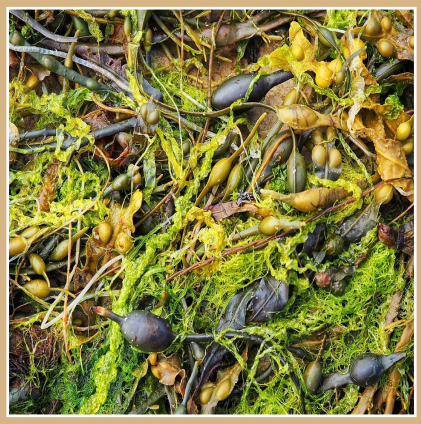
HAS A DECOMPOSING TIME OF 30 YEARS, BUT IS OFTEN BURNED AND EMITES CO2

?????

BAD FOAMS !

Collage of synthetic foams

GOOD FIBERS !









Collage of plant fibres

PRODUCTION OF FOAMS !

Photo (2)

(2) https://agriwatch.dk/Nyheder/Industrien/article13839363.ece

PRODUCTION OF FIBERS !

Photo (3)

(3) https://lf.dk/aktuelt/nyheder/2021/april/lang-vej-til-maal-i-regeringens-udspil-om-landbruget

DIPLOMA CANDIDATE

KIM LUND

FIELD

INDUSTRIAL DESIGN

SCHOOL

THE OSLO SCHOOL OF ARCHITECTURE AND DESIGN

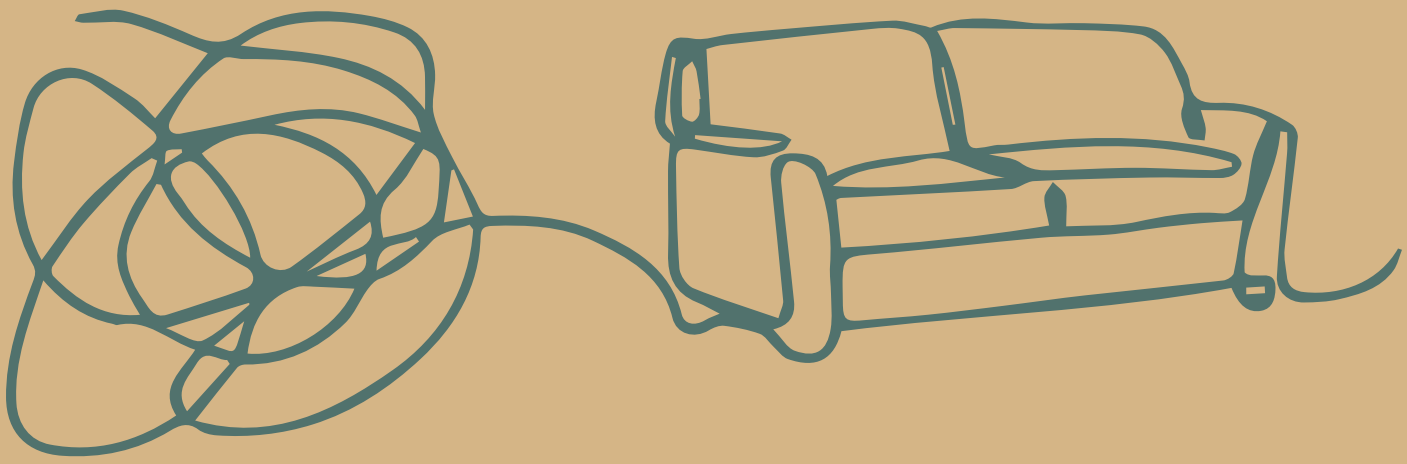
SUPERVISOR

HILDE ANGELFOSS

TABLE OF CONTENT:

CHAPTER 1

INTRODUCTION



REPLACING FOAM TO CREATE A MORE SUSTAINABLE FURNITURE

Chairs and beds are products that we depend on in our everyday lives. They are products we cannot live without. But these products are not sustainably made, because of the foam they contain. The foam they use today has a cruel manufacturing process, and it cannot be recycled but only downcycled. The foam's material is called polyurethan and is derived from petroleum.

*"Globally, furniture foam, accounts for **105 million** tonnes of CO2 emissions annually. One armchair for example, emits an average of **43 kg** CO2 emission, almost half of which is due to the furniture foam."*(4)

In this diploma I look in to finding a plant-friendly alternative through material exploration and testing. I want to test out making furniture stuffing out of plant fibre that is completely free of petroleum, has a sustainable manufacturing process and can biodegrade after its lifetime, and go back to nature, and be fertilzer for new plant fibre stuffing to come.

With the finding from the material exploration and testing, I will deisgn a modern take on what a sustainable sofa should look like today.

(4) https://www.agoprene.com/

WHO ARE THE USERS ?

Since my final product will be an upholstered furniture, it must be universally designed so that it can be used by all ages, both genders, high and low. When that is said, those who are going to buy the furniture are:

PRIMARY:

Adult couples or singles aged 35-60 years who are environmentally conscious and want to re-place their old furniture with a new one that is durable and has good comfort that can follow them through life.

SECONDARY:

Young couples or singles aged 20-35 years, who are environmentally conscious and want to buy a durable piece of furniture with good comfort that can follow them through life.

EXTREME:

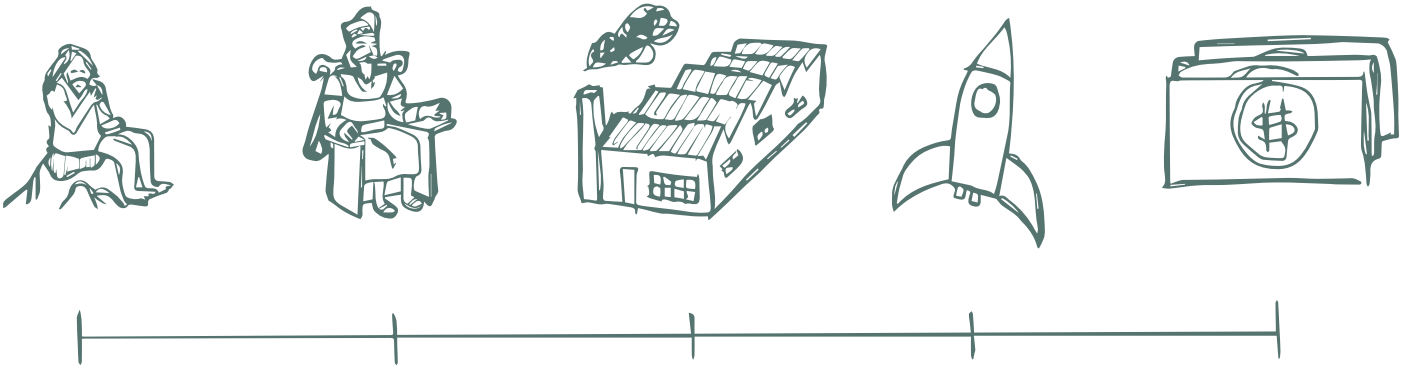
Couples and singles with allergies who are sensitive to some textiles and stuffings.

HISTORY OF UPHOLSTERY

The first furniture in the world was probably in the stone age, where our ancestors placed some animal skin or hay on a stone and sat on it to get a little comfort.

More traditional upholstery of furniture began in the 17th Century, when it became fashionable for the wealthy to buy luxurious items for their home, such as cushion on their chairs. The stuffing at that time was comprised of basic materials such as feathers, animal hair, grass, wool, and saw-dust. This type of furniture stuffing continued up to the 1900s.

Polyurethan was invented and produced in Germany in 1937. It was first in 1954 that the large-scale production of the flexible polyurethan foam started in Europe. Later on, the “Memory foam” that also consists of polyurethan was developed by NASA in 1966. In just a few years polyurethan became the number 1 choice of foam for furniture upholstery, car seats, and the bed industry. And it still is today, because of its many qualities such as: it’s easy to work with and can be molded and pressed into a shape, gives good comfort, and is cheap to produce.(5)



Stone Age

Stone with animal fur & hay

17th Century

Fashionable cushion for the wealthy

1937 - 1954

Polyurethane was invented and large-scale production started

1966

NASA invented Memory foam

Today

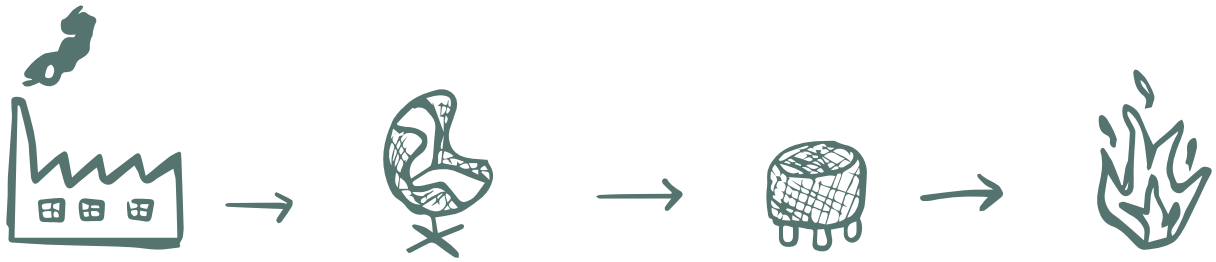
Still large-scale production of polyurethane

(5) https://signatureupholstery.co.uk/history-of-upholstery-foam-usage/

NOT A GOOD MATERIAL ?

It’s because polyurethan currently has a linear production model: new materials are produced in a non-sustainable way, and it’s not possible to recycle, but only downcycled. It’s possible to grind it up in smaller pieces and used for harder stuffing in furniture like a stool. But the more that is downcycled, the harder stuffing material is in circulation, and we don’t need all that hard stuffing material, and in the end, it’s going to be burnt, and have a bad effect on the environment.

“Because of foams property, it is a preferred material in furniture, bedding, automotive seating, athletic equipment, packaging, footwear, and carpet cushion. It also plays a valuable role in soundproofing and filtration. In all, over ***1.5 billion pounds of foam are produced and used every year in the U.S. alone****.” (6)*



WHAT ARE WE DOING TODAY ?

For a long time, furniture companies have been looking for an alternative to reduce dependency on foam. Today there are many people who are doing research into making new, more sustainable material with plant and animal fibre, but they are not used in the furniture industry yet. It’s a relatively new problem we’ve been exposed to and made visible, there is a pressure to solve it, but the solution is not there yet.

Like IKEA They want to reduce their total climate footprint by an average of 70% per product by 2030, they have also looked into using wood fibre as furniture stuffing. They say:

"At IKEA, we want to be more friendly to the environment. Conventional foam is not biodegradable. So, when a customer discards a mattress or a sofa, and if it goes to the landfill, the foam stays there and does not decompose”.

“But polyurethane foam is not easy to replace. It's quite a good material because of its properties, such as being lightweight, comfortable, and easy to shape.” (7)

(6) https://www.pfa.org/what-is-polyurethane-foam/
(7) Replacing foam to create a more sustainable icon (ikea.com)

WHAT IS THE SOLUTION ?

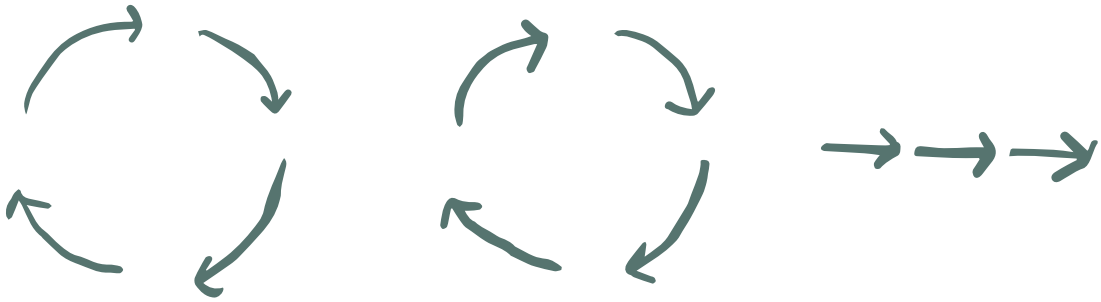
I have read the book “Cradle to Cradle” and I think it gives a good, qualifying answer. We need to change our current way of thinking and doing, and we need to think about the future, in a more sustainable way.

If we put products into production, they must be part of a circular life cycle that creates value for people, environment, and economy. It’s not just about minimizing the negative effects on the environment, by producing less waste, and saving some resources. Less bad is still bad.

In the book they suggest: We have to eliminate the concept of waste. In the near future it is important that we design with the concept in mind: that waste does not exist. To achieve this we have to change our mindset and follow a method called ”form follows evolution”, which goes into depth on how to protect materials by sorting them in two life cycles:

When it comes to understanding what and which material you should design with, it is important that we understand how the planet is affected by two different life cycles. The first one is the biosphere (the cycles of nature) and the second one is the technosphere (the cycles of industry). With the right design, all materials will be able to be sorted in these two life cycles.

Products can be composed either of materials that are biodegradable and become fertilzer for the biosphere, or of recyclable materials that stay close-looped in the Technosphere, which continually circulate as valuable nutrients for industries. (8)



Biosphere
(the cycles of nature)

Technosphere
(the cycles of industry)

Linear model
(bad for the inviroment)

(8) Cradel to Cradel by Braungart, 2002

CHAPTER 1 CONCLUSION

WHY USE PLANT FIBERS ?

I can conclude, after doing desktop research, talked with my supervisor Hilde Angelfoss, that has worked all her life in the furniture industry for the companies Stressless and Stokke, talked to the world-famous furniture designers: Anderssen&Voll, and been on a lecture on sustainable furniture industry held by FLOKK, the largest and leading company in sustainable furniture manufacturing in Norway.

SYNTHETIC FOAM

The most sustainable material for furniture would be in the future synthetic foam, if scientists find a way to create it with a sustainable manufacturing process and find a way to recycle it. Because then you don't need a lot of land use to create the material, as you need to create fibres form animal or plants.

"Land use is bad because of the deforesting, fertilization, and the use of agricultural chemicals to the soil and land use will also decrease biodiversity." (9)

But because you today cannot create synthetic foam in a non-cruel production, and it cannot be recycled, and that it creates more CO2 emissions than animal or plant fibre, it's not an ethical nor sustainable choice to use.

ANIMAL FIBRE

Today the most sustainably produced furnitures on the market are made with animal stuffing (wool and feathers), such as the design brand "HAY" with their sofa "Arbour Eco", that got the green labs for sustainability "Ecolabel" and "svanemærket".

The sofa Arbour from HAY designed by the Norwegian designers Andreas Engesvik and Daniel Rybakken. (10)

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(9) https://www.epa.gov/report-environment/land-use
(10) ARBOUR 3-SEWSOFA - Sofas - HAYSHOP.NO

The disadvantages of using animal fibre is that you cannot create them without cruelty to animals, there is also a bigger land use in creating animal fibre than plant fibre, as we can see from “CIRCUMFAUNA” data’s which is a research regarding the use of animals and their environmental impacts.

*“From this we learn that a whopping **367 times less** land is required to grow one bale of Australian cotton, as compared to growing one bale of Australian wool.”* (11)

The last disadvantage is animal fibre is not allergy friendly and scratchy on skin. That is a big problem for all the people with allergies to wool and feathers. So that is why I will conclude that animal fibre is the second least ethical and sustainable choice to use.

PLANT FIBRE

The conclusion for why plant fibre is the most ethical and sustainable stuffing for furniture and why I think we should use it instead of synthetic foam and animal fibre, is that there is no cruelty in the way it’s produced, and it has less land use than animal fibre.

If you look at the disadvantages of plant fibre, suchs as: “not very durable” and a “low density”; That is something I want to test out. whether it’s true for all different plant fibres in my material exploration and testing, or if some plant fibres are durable and have a high density?

The question is also if it’s bad that it’s “not durable”, when you can just create new cushions in a sustainable way for your furniture and let the older cushions decompose and be fertilizer for new plant fibre stuffing to come. And if it has a “low density” is it bad to just use more stuffing, when plant fibre is easy to process?

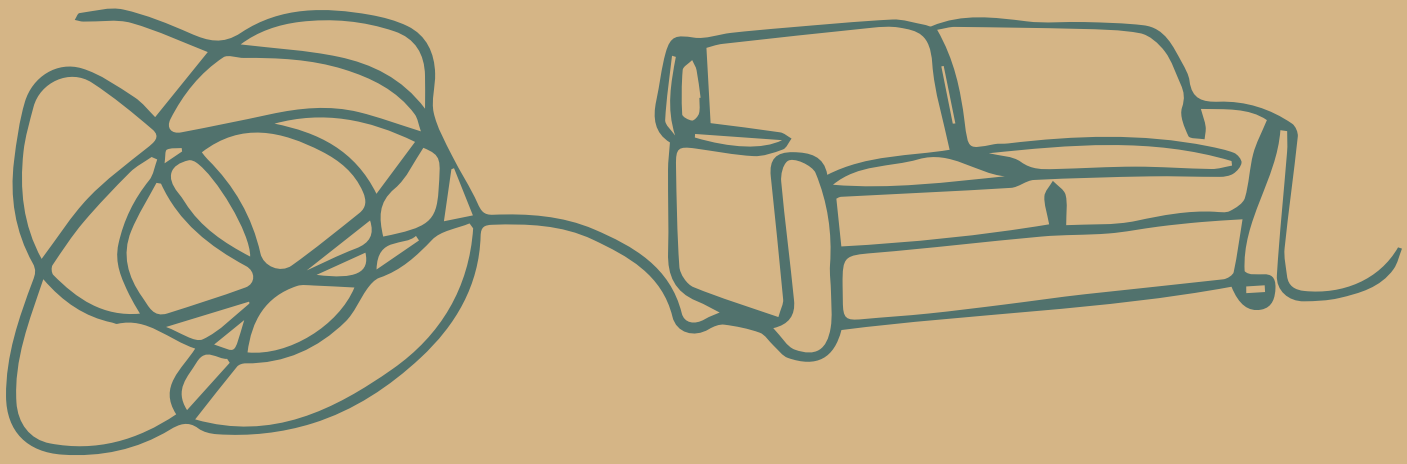
	PLANT	ANIMAL	SYNTHETIC
MATERIALS	FIBER SEEDS	FEATHERS WOOL	WADDING FOAM
DISADVANTAGES -	NOT VERY DURABLE[i] WATER & LAND USE[ii] LOW DENSITY [iii]	CRUELTY TO ANIMAL[iv] WATER & LAND USE[v] ALERGIES / SCRACY [vi]	CRUEL PRODUCTION[vii] LONG DECOMPOSE TIME[viii] NON-RECYCLABLE [ix]
ADVANTAGES +	BIOGRADABLE [x] REDUCTION OF CO2 [xi] EASY PROCESSING [xii]	BIOGRADABLE[xiii] REDUCTION OF CO2[xiv] FIRE RESISTANT[xv]	CHEAP[xvi] DURABLE[xvii] LIGHT WEIGHT [xviii]
MOST ETHICAL			

This chart shows disadvantages and advantages of: plant fibre, animal fibre, and synthetic foam
To see alle the references to the answers in this chart I refer to Appendix A .

(11) https://circumfauna.org/our-mission

CHAPTER 2

APPROACH



HOW TO APPROACH THIS PROJECT?

In this project I'm going to design a sofa. There are many ways to design a sustainable sofa and there are many ways to achieve a good comfort. This is going to be part of my exploration and material testing.

It's not only the sofa's stuffing that makes a good comfort, it's the sofa in its entirety. You must consider what is under the stuffing, what kind of flexibility to find in the seat and in the back of the furniture. Also, the shape of the furniture is very important, to give it good ergonomics.

I want to test 9 plant fibres against 6 reference foams (synthetic foams that are used today in the furniture industry) This project is going to consist of 3 steps:

STEP 1:

I want to start making a desktop research of practical information of all the fibre's and reference foam's qualities.

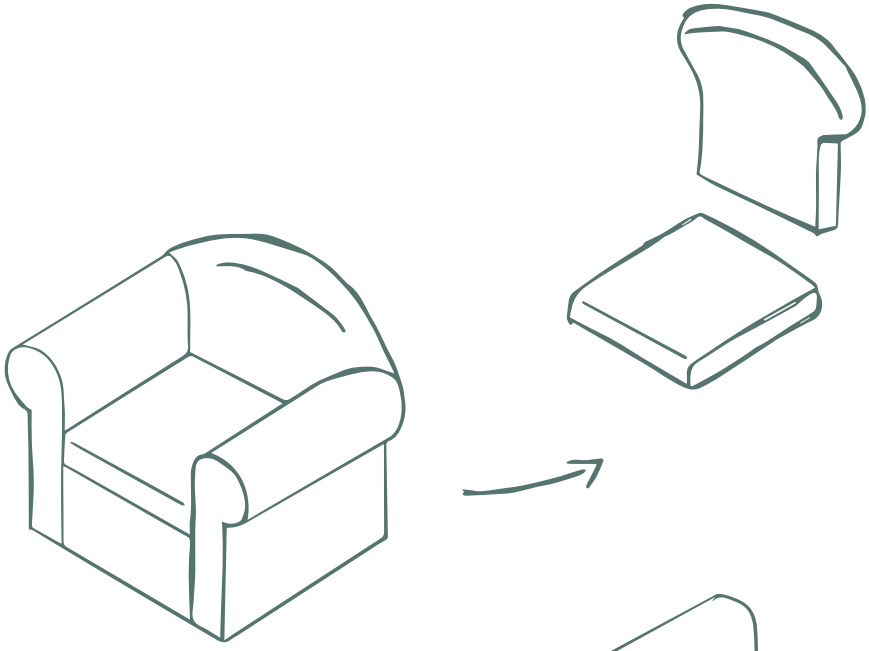
STEP 2:

Then I will test the fibres and foams in the "USE AND MAINTAIN" requirements that you would look for in a sofa with the test equipment that is available at AHO´s workshops. I will do tests in durability, the effect on our sense, and the sitting comfort.

STEP 3:

After the testing in "USE AND MAINTAIN", I will use the insight in the design exploration to design a modern take on a sustainable sofa. After choosing the final design for a sofa, I will test the sitting comfort in a working prototype with a group of users.

PROJECT SPECIFICATIONS

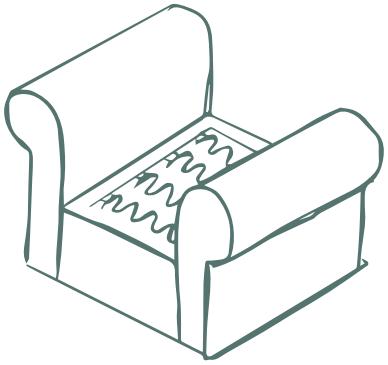


STUFFING

Test 9 plant fibres &
6 foams.

PRATICAL INFO

Information about the fibre's
and reference foam's
qualities.



FLEXIBILITY

Differnt way of flexibilty in
constructions.

MUST

Sustainable manufacturing
(It must be produced in a sustainable way with the least possible carbon footprint)

Go into the Technosphere or Biosphere.
(Make furniture stuffing from materials that can be recirculated or biodegrade.)

Disassembly.
(All material must be able to be repaired, reused and recycled)

Good comfort
(Its important that the sofa has a good comfort so people will use it)

SHOULD:

Flatpack
(Take up less space during transportation) minimal use of space.

Allergy friendly
(It must be made of a material that everyone can tolerate.)

Locally produced
(It should be locally produced in Norway, Scandinavia or Europe, to avoid CO2 impact from transportation)

COULD:

Price
(The material could be able to be manufactured at a competitive price.)

Industrial quantities
(The material could be able to be produced in a large scale today.)

Molded, pressed, or cut
(It could be able to be produced in a large scale, with industrial tools)

CHAPTER 2 CONCLUSION

MATERIAL DRIVEN DESIGN METHOD (MDD)

I have approached this project by using the “The material driven design method (MDD)”. This is the method you use when working with exploring and testing and creating materials. This is how the method works:

At its core, Material Driven Design is about understanding the physical and chemical properties of different materials, and using this knowledge to create designs that are optimized for the specific properties of those materials. This involves selecting materials that are best suited for the intended application.

In this method you can achieve two things, either you can test existing materials (that’s what I’m going to do with plant fibres) or you and try to create new materials (that part I will save for the scientists)

So in my project when I’m testing existing materials, you can almost compare “The Material Driven Design Method” to the regular “Doble Diamond Process”, with the research phase (Discover, Define) and the design phase (Develop, Deliver), but instead of having one research phase you have two parallels: one for the material exploration and one for design exploration.

RESEARCH PHASE FOR THE MATERIAL EXPLORATION

The Material Driven Design process typically involves several steps, including material selection, testing and analysis. During the material selection phase, the designers consider a range of factors such as durability, performance, sensory experience, and sustainability, and choose the materials that best meet their needs.

RESEACH PHASE FOR THE DESIGN EXPLORATION

They then conduct testing and analysis to better understand the properties of the selected materials and use this information in the creative process to develop and refine their designs. One of the key benefits of Material Driven Design is that it allows designers to create more sustainable and efficient designs, by taking advantage of the unique properties of different materials.

DESIGN PHASE

When finished with the two research phases (Discover and Define), you have a material proposal and a design proposal, that you then combine and develop further in the last design phase, where you develop and deliver the result. (12)

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(12) https://re.public.polimi.it/bitstream/11311/979536/1/MDD%20article.pdf

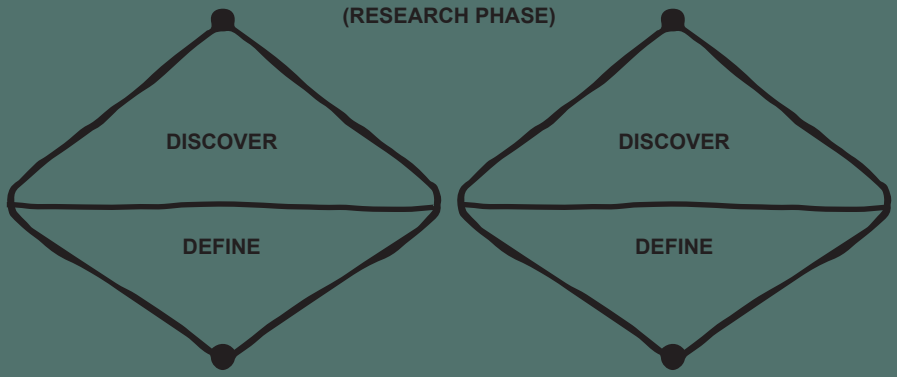
INTRODUCTION

APPROACH & METHODS

MATERIAL EXPLORATION

DESIGN EXPLORATION

(RESEARCH PHASE)

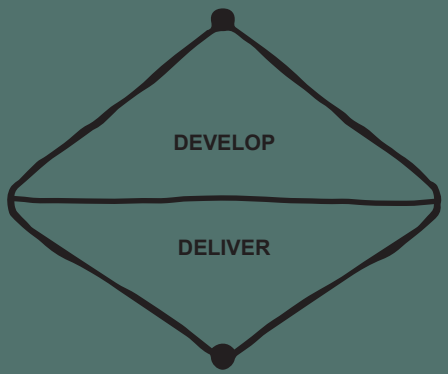


MATERIAL PROPOSAL

DESIGN PROPOSAL

PRODUCT DEVELOPMENT

(DESIGN PHASE)

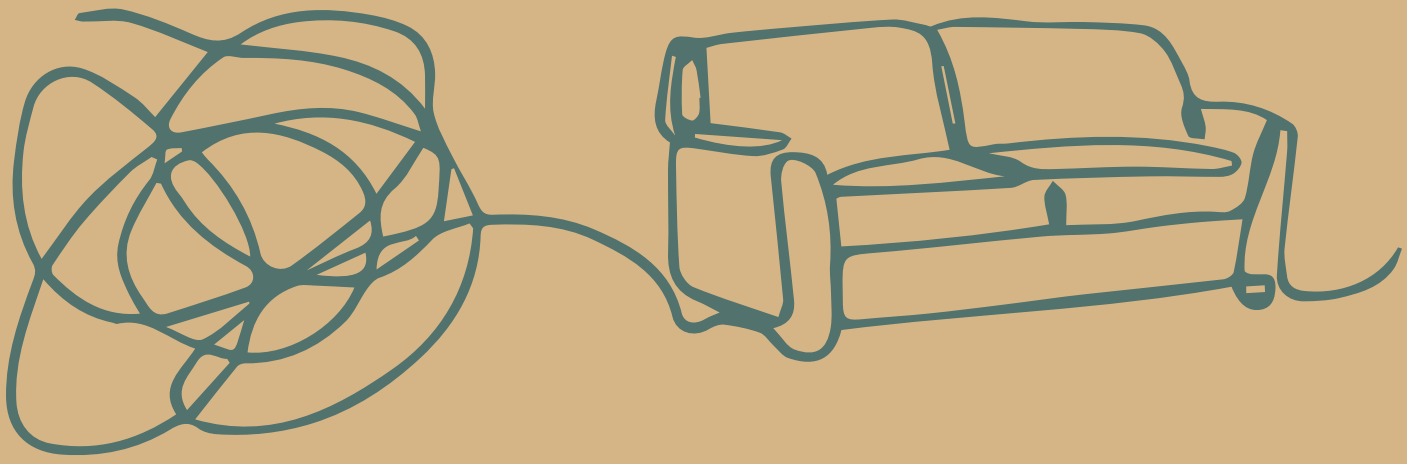


FINAL PRODUCT & TEST

CONCLUSION & REFLECTIONS

CHAPTER 3

MATERIAL EXPLORATION



MY MATERIAL JOURNEY

In this material exploration you can read about which plant fibres and synthetic foams I have tested and you can see how I prepared the plant fibres for the tests by sewing homemade small scale sofa cushions. This exploration is going to consist of 3 steps:

STEP 1:

How I have done desktop research on practical information about all the different plant fibres' and synthetic foams' qualities.

STEP 2:

How I have carried out tests in the category: "USE AND MAINTAIN" of a sofa. Where I have tested: durability, the "EFFECT ON OUR SENSES", and the sitting comfort.

STEP 3:

In the end of this material exploration you can read a conclusion, were I have shown my findings from the testing and got useful feedback and insight from Eddie King, a professional furniture upholsterer for 40 years.

PLANT CLASSIFICATION

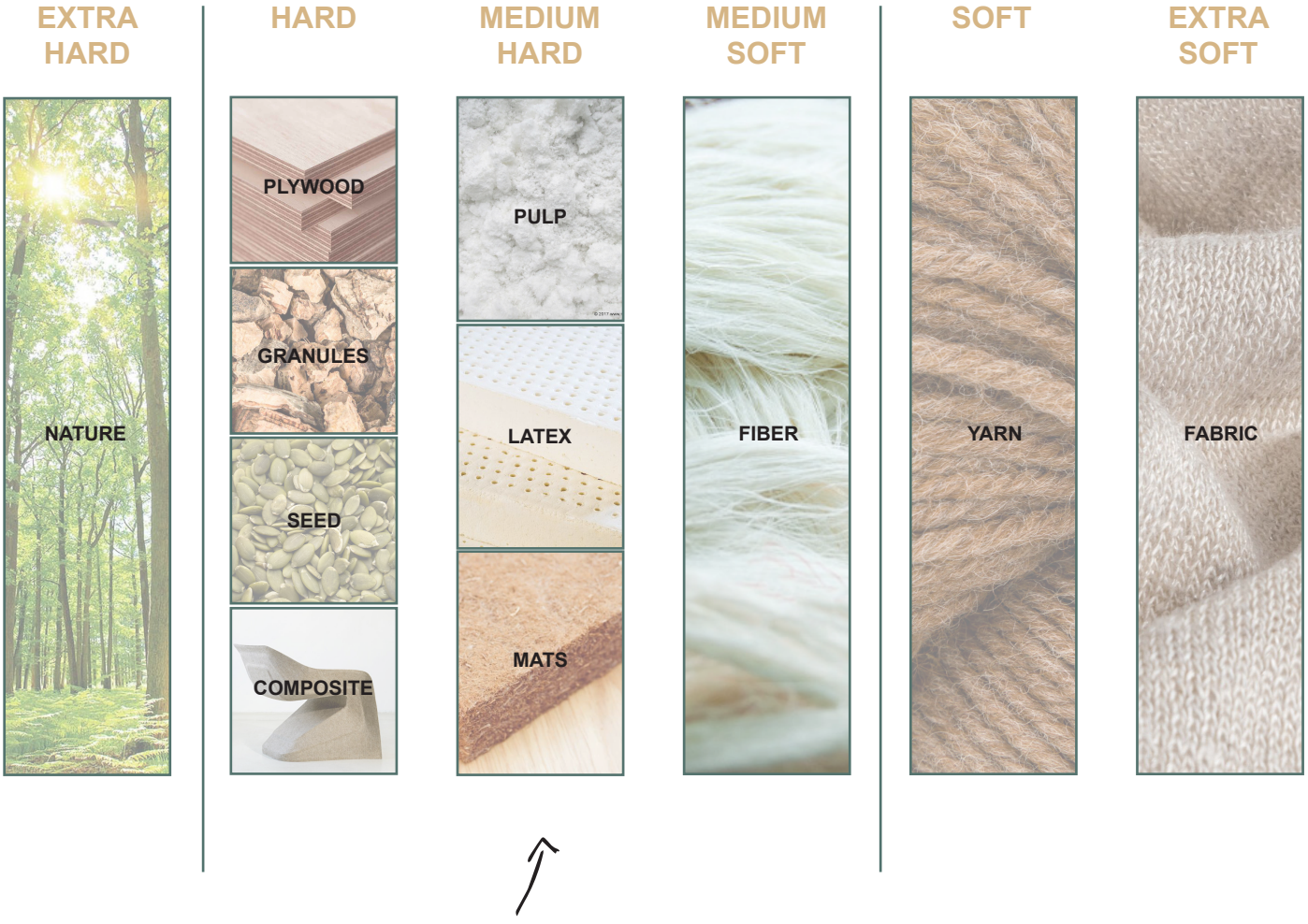
These are the differnt plant fibres I will test

PLANT FIBRES

STEM	STALK	LEAF	GRASS	SEED
				
Talalay	**Hemp**		**Bamboo**	**Coconut**
Wood				**Buckwheat**
Linen				**Loofah**
				Kapok

Collage of plant fibres classication

PLANT MATERIALS



Im going to test plant fibres in these categories

Collage of plant materials in a soft to hard scale.

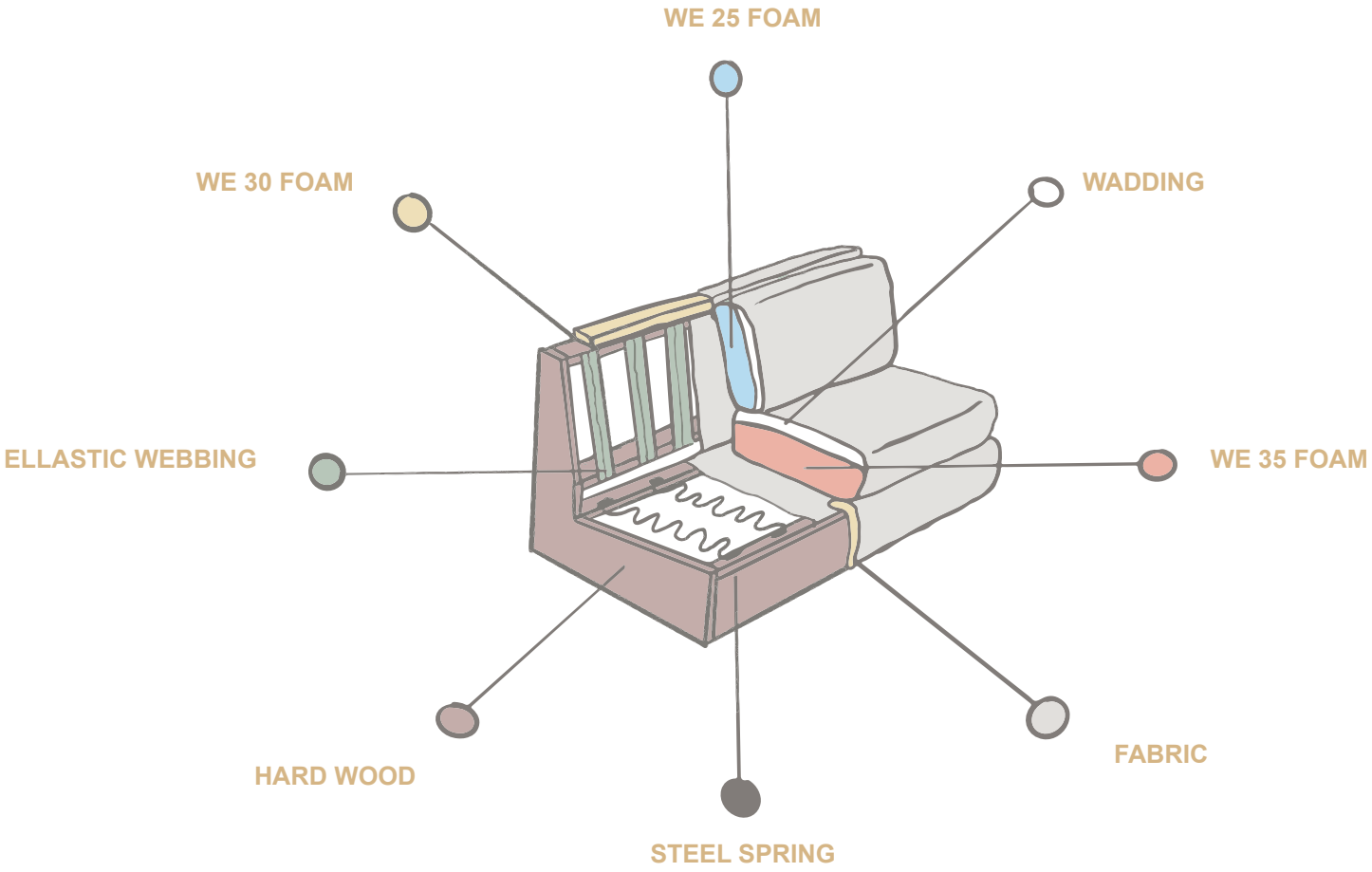
EXPECTATIONS FOR A SOFA

A sofa today is built with many different materials including various foams, and flexible materials, to give it a good comfort.

The lifespan of a sofa today can vary greatly depending on several factors, including the quality of the materials used to make it, how well it is maintained, and how often it is used.

A well-made sofa with high-quality materials can last for many years, even up to 15-20 years or more, if it is cared for properly and not subjected to excessive wear and tear. (13)

On the other hand, a low-quality sofa made with cheaper materials may only last 7-15 years before it begins to show signs of deterioration. (14)



(13) https://www.parachutehome.com/blog/when-to-replace-furniture-couches-chairs-beds
(14) https://www.plumbs.co.uk/articles/inspiration/how-long-should-a-sofa-last/

PREPARING FOR THE TEST

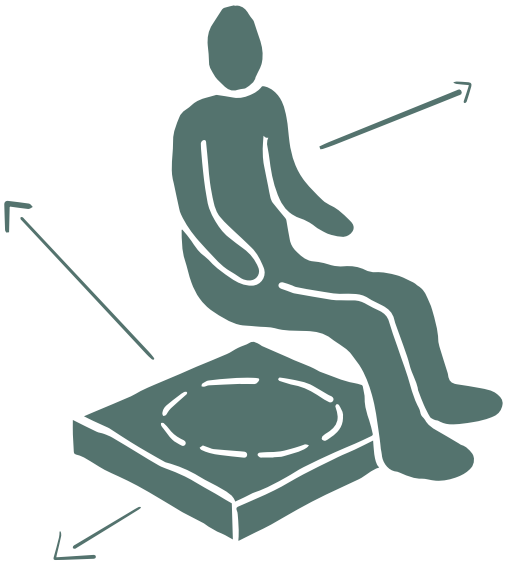
I have made desktop research to find the average proportions of a human, a butt, and a sofa cushion and then I have divided it into a scale of 1:4. I have chosen to do that because it's expensive to buy small volume of all the plant fibres and it's easier to do the test in smaller scale with the equipment available at the school workshops.

BUTT

100 cm (15)
(in circumference)

SCALE 1:4

25 cm (17)
(in circumference)



HUMAN

80 KG (16)

SCALE 1:4

20 KG

CUSHION

H: 18 cm x L: 80 cm x W: 80 cm (14)

SCALE 1:4

H: 4,5 cm x L: 20 cm x W: 20 cm

(15) https://bedbible.com/butt-size-chart-statistics/
(16) https://en.wikipedia.org/wiki/Human_body_weight
(17) I have these measurements by sizing sofas in a store and at school

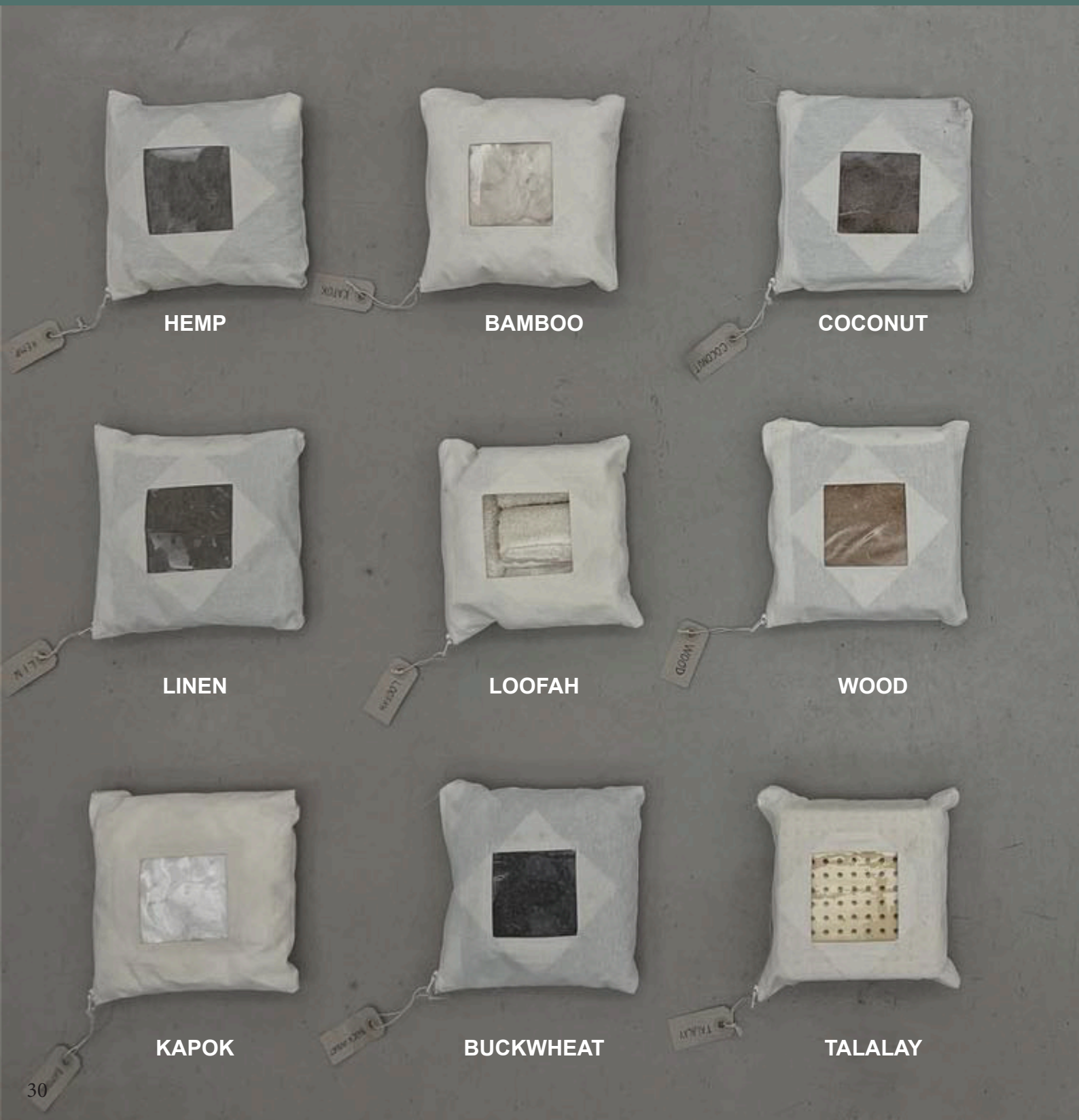
9 PLANT FIBRES

I started to require as many plant fibres as possible and ended up with 9. The ones I'm going to test are:

- 4 can grow in Europe (HEMP, LINEN, WOOD, and BUCKWHEAT)

- 5 can grow in Asia (BAMBOO, COCONUT, LOOFAH, KAPOK, and TALALAY)

To learn about the differnt synthetic foams' areas of use, I visit "Skumplast-Senteret AS" in Oslo. Here they recommend to test the following 6 synthetic reference foams:



6 SYNTHETIC FOAMS

- (WE 35) is the most recommended foam to used for both seat and back cushions.
- (WE 30 and WE 25) are only used in the back cushions, if you want it softer.
- (WADDING) is used on top of the foam to make the cushion softer and give it more volume.
- (FOAM MIX) is a mixed material consisting of 64% hemp / 15% pet / 21 % pp.
- (DOWN FOAM) downcycled foam used as harder stuffing.

PRATICAL INFO

Before testing the plant fibres, I have done desktop research, to gather practical information about all the plant fibres and synthetic foams, to get a basic knowledge of how their performances are in relations to sustainability and maintenance of the sofa.

One advantage of desktop research is that it can be conducted quickly and efficiently and can often provide a broad overview of a particular topic or issue.

But on the other hand, there are also disadvantages to desktop research. One limitation is that the quality and reliability of the information obtained can vary widely, depending on the source and the accuracy of the data. (18)

And in this project, where I'm searching for information about the sustainability and maintenance of the sofa with different plant fibres and synthetic foams, I learned that it is such an unresearched topic that there is not much scientific info out there yet. That means that not all my sources are trustworthy, because they come from non-scientific sources but just articles and websites, were I cannot ensure the credibility of the sources, but it can give a superficial answer.

I have shown all my desktop research in the chart on the right, and divided it into 3 color codes to make it easier to see what is a positive (green), neutral (yellow), negative (red) outcome from the research conducted.

(18) https://www.questionpro.com/blog/desk-research/

PRATICAL INFORMATION	CAN YOU WASH IT?	DOES IT ABSORBS SWEAT?	ALLERGIES?	FLAMMABLE?	VOLUME OF 1 KG	PRICE 1 KG	DESOMPOSE TIME	CAN IT BE MADE IN EUROPE?
PLANT:								
HEMP	Yes[i]	Yes[ii]	No[iii]	Fire resistant[iv]	2.469 cm^3	Ca 38 nok[v]	2 weeks[vi]	Yes[vii]
KAPOK	Possible[viii]	Yes[ix]	Some are[x]	Yes[xi]	3.921 cm^3	Ca 24 nok[xii]	No info	No[xiii]
BAMBOO	Yes [xiv]	Yes[xv]	No[xvi]	Fire resistant[xvii]	1.250 cm^3	Ca 3 kr [xviii]	7-25 weeks[xix]	Possible[xx]
LINEN	YES[xxi]	YES[xxii]	NO[xxiii]	Yes[xxiv]	1.526 cm^3	No info	2 weeks[xxv]	Yes[xxvi]
BUCKWHEAT	Possible[xxvii]	No info	Yes[xxviii]	Yes[xxix]	1.010 cm^3	Ca 8 nok[xxx]	3-4 weeks[xxxi]	Possible[xxxii]
LOOFAH	Yes[xxxiii]	No info	No info	Yes[xxxiv]	3.076 cm^3	Ca 5-8 nok[xxxv]	4-6 weeks[xxxvi]	No[xxxvii]
COCONUT	Possible[xxxviii]	Yes[xxxix]	No[xl]	Yes[xli]	1.418 cm^3	Ca 3 nok[xlii]	1 year [xliii]	No[xliv]
WOOD	No info	No info	No info	Fire resistant[xlv]	2.380 cm^3	No info	28 weeks[xlvi]	Yes[xlvii]
TALALAY	Possible[xlviii]	No[xlix]	Yes[l]	Fire resistant[li]	2.702 cm^3	Ca 20-40 nok [lii]	1-2 year[liii]	No[liv]
SYNTHETIC:								
WADDING	Yes[lv]	Not much[lvi]	Some are[lvii]	Yes[lviii]	3.448 cm^3	Ca 10-20 nok[lix]	20-30 year	Yes[lx]
FOAM WE 25	Possible[lxi]	Not much[lxii]	Some are[lxiii]	Yes[lxiv]	4.878 cm^3	Ca 30 - 35 nok [lxv]	20-30 year	Yes[lxvi]
FOAM WE 30	Possible[lxvii]	Not much[lxviii]	Some are[lxix]	Yes[lxx]	4.166 cm^3	Ca 30 – 35 nok [lxxi]	20-30 year	Yes[lxxii]
FOAM WE 35	Possible[lxxiii]	Not much[lxxiv]	Some are[lxxv]	Yes[lxxvi]	3.389 cm^3	Ca 30 - 35 nok [lxxvii]	20-30 year	Yes[lxxviii]
FOAM REC	Possible[lxxix]	Not much[lxxx]	Some are [lxxxi]	yes[lxxxii]	1.250 cm^3	Ca 30 – 35 nok [lxxxiii]	20-30 year[lxxxiv]	Yes[lxxxv]

This chart shows the outcome of my desktop research. To see alle the references to the answers conducted in this chart I refer to Appendix B.

DURABILITY TEST

The professional and reliable way to test the durability of a furniture cushion, is by doing a hardness test.

Hardness testing of sofa cushions is an important process to ensure that the cushions provide the necessary support and comfort to the users. There are two methods used to measure the hardness of sofa cushions.

1.INDENTATION LOAD DEFLECTION (ILD)

ILD testing involves measuring the force required to compress a cushion to a certain depth, typically 25% of the cushion's thickness. This test provides an indication of the cushion's firmness and supportiveness. A higher ILD value indicates a firmer cushion, while a lower ILD value indicates a softer cushion.

2.INDENTATION FORCE DEFLECTION (IFD)

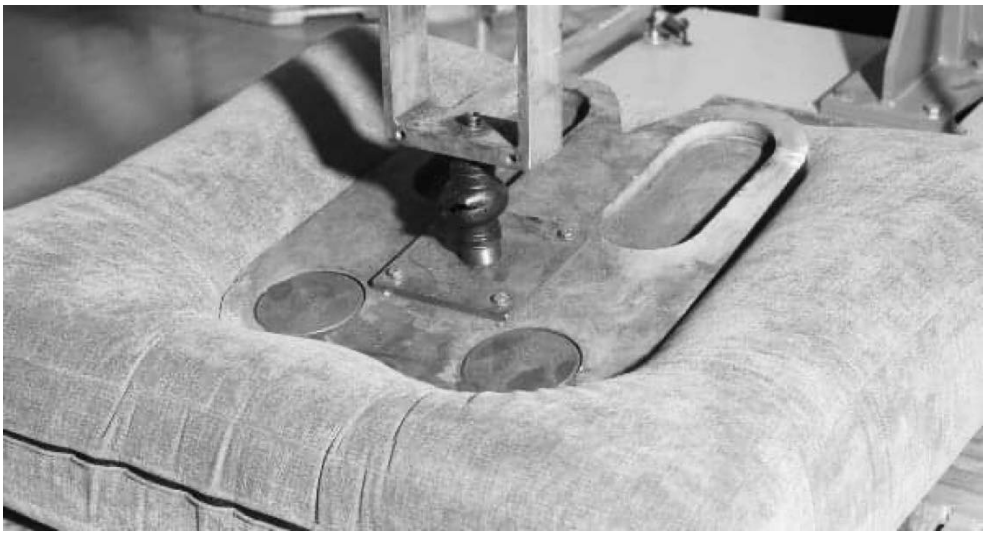
Compression testing involves applying a force to the cushion and measuring the amount of deformation that occurs. This test is used to evaluate the cushion's resilience and ability to maintain its shape over time. A cushion that quickly regains its shape after compression is considered more resilient and durable.

Both tests can be performed using specialized equipment, such as an “indent meter” or a “chair test machine”. (19)

Because the school doesn’t have these machines available in the workshops, and it’s very expensive to outsource the test to a professional engineering company, I have done it in a simplified homemade way, that is not as reliable, because of not using professional equipment and test full size cushions. However, it still gives a correct indication of the durability of my 9 plant fibres and 6 synthetic foams.

(19) https://www.satra.com/spotlight/article.php?id=485

This photo shows the machine that does the test: 1. INDENTATION LOAD DEFLECTION (ILD) (20)



This photo shows the machine that does the test: 2. INDENTATION FORCE DEFLECTION (IFD) (20)

(20) https://www.satra.com/spotlight/article.php?id=485


WE 25

MY HOMEMADE TEST MACHINE 1

1.INDENTATION LOAD DEFLECTION (ILD)

To perform this test, you should use a machine called “indent meter” to measure the hardness of a cushion, and press down 25 % on a full size cushion. (21)

Instead, I used a pillar drilling machine and attached a plate, indicating 1:4 scale of a butt, then pressed it down 25 % on my 1:4 scaled cushion, that was placed on a weight, that gave me the result in kg, where a high weight indicates a firmer cushion, while a lower indicates a softer cushion.
.

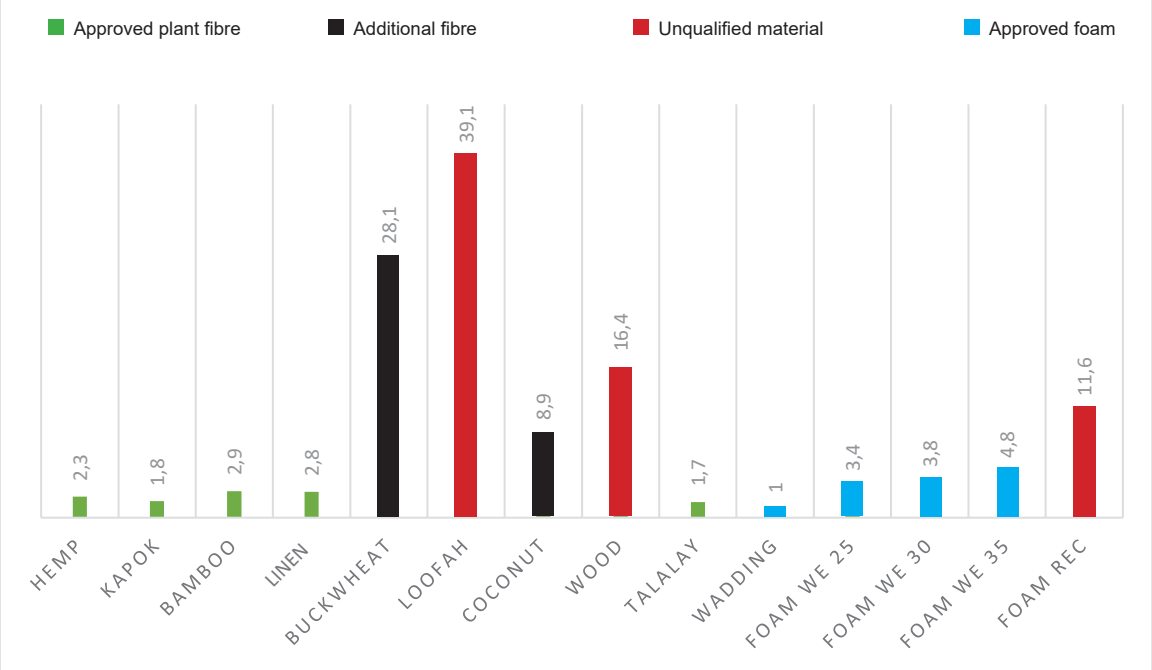
HARDNESS TESTING	WITHOUT PRESS KG	PRESS FULL AREA KG	PRESS SMALL AREA KG	PRESS PATTERN LEFT?
PLANT:				
HEMP	0,81	5,20	2,30	Yes (very little)
KAPOK	0,51	6,60	1,80	Yes (very little)
BAMBOO	1,60	3,30	2,90	Yes (very little)
LINEN	1,31	7,80	2,80	Yes (little)
BUCKWHEAT	1,98	59,7	28,10	Yes (much)
LOOFAH	0,65	66,10	39,10	No
COCONUT	1,41	31,40	8,90	No
WOOD	0,84	41,60	16,40	No
TALALAY	0,74	3,20	1,70	No
SYNTHETIC:				
WADDING	0,58	4,30	1,00	Yes (very little)
FOAM WE 25	0,41	7,10	3,40	No
FOAM WE 30	0,48	5,90	3,80	No
FOAM WE 35	0,59	8,70	4,80	No
FOAM REC	1,60	27,80	11,60	No

This chart shows the outcome data of my homemade test of: 1.INDENTATION LOAD DEFLECTION (ILD)

(21) https://www.satra.com/spotlight/article.php?id=485

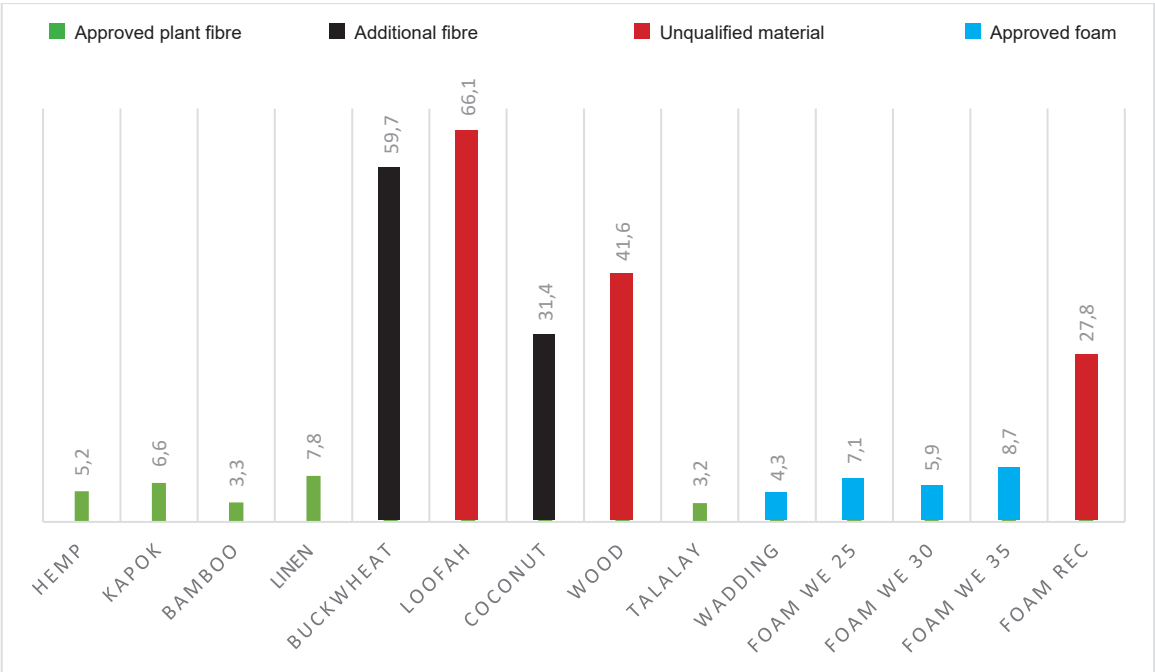
THE RESULTS

PRESS (SMALL AREA) IN KG



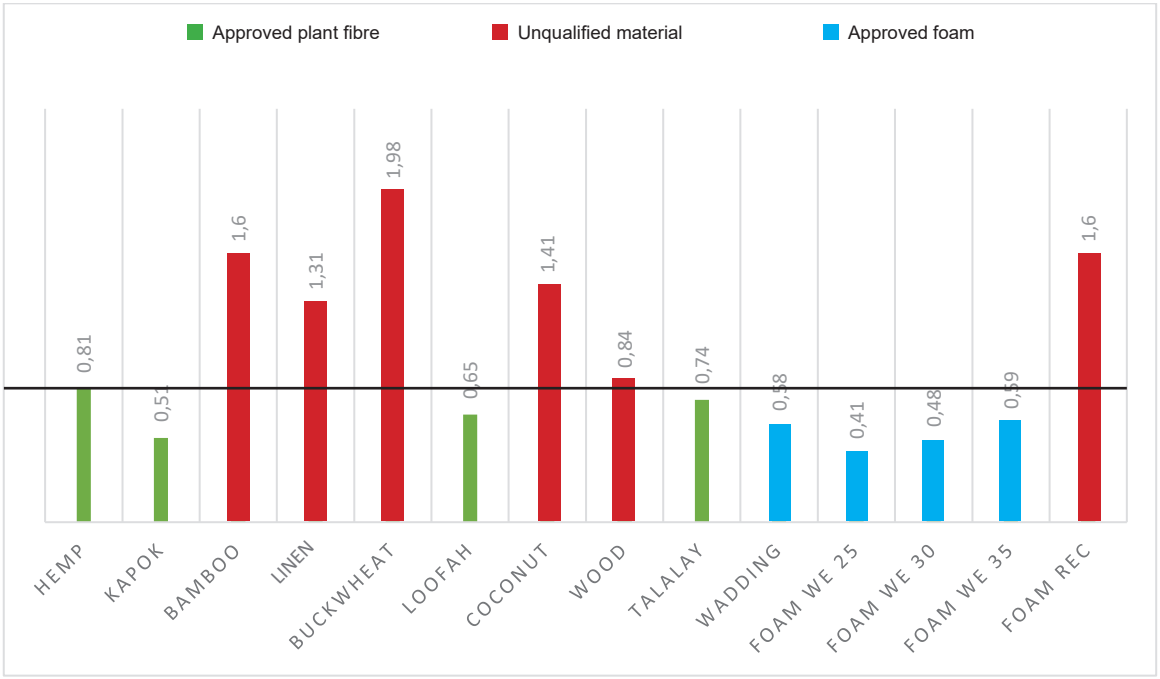
This diagram shows the results of pressing with a small area (1:4 scale of a butt). Here we see the “Approved plant fibres” that are closest to the “Approved foams”. But the “Approved foams“ still can sustain a higher kilogram force and is then firmer than the “Approved plant fibres“. Here a solution could be to combine plant fibres and use one of the “Additional fibres“ to get the exact wanted firmness.

PRESS (FULL AREA) IN KG



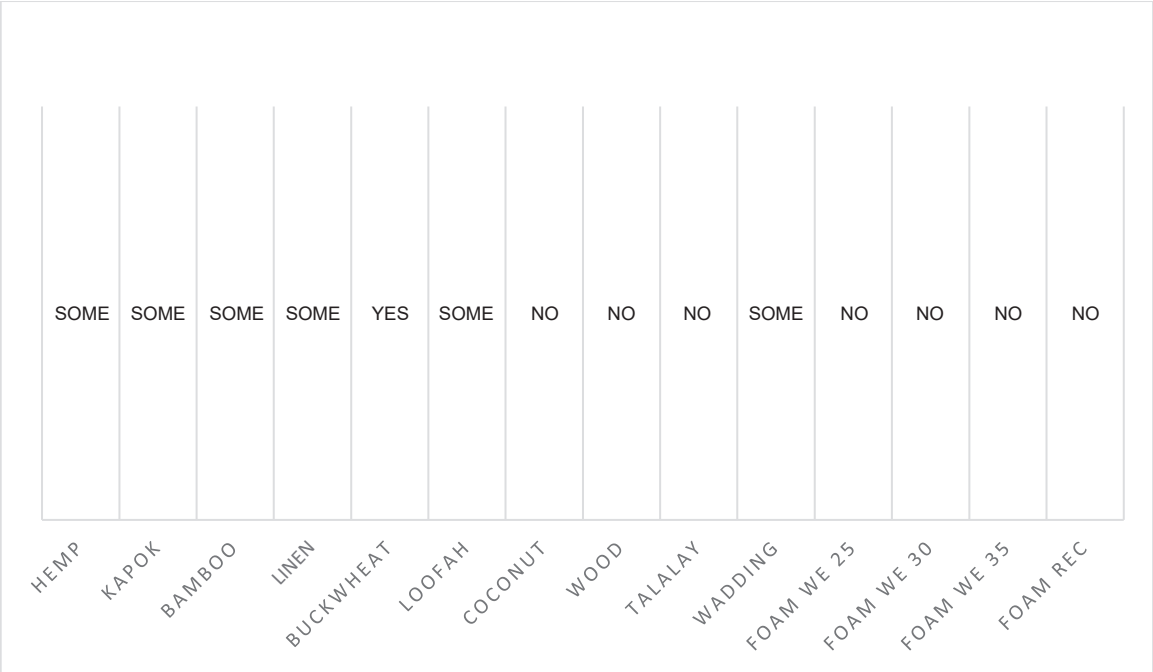
This diagram shows the results of pressing with a full area (press on the entire area of my test cushion) This gives os almost the exact same results as from above (pressing with a small area) and gives us the same conclusion to add a “Additional fibre“ to get the exact wanted firmness.

WEIGHT OF THE FIBRES & FOAMS

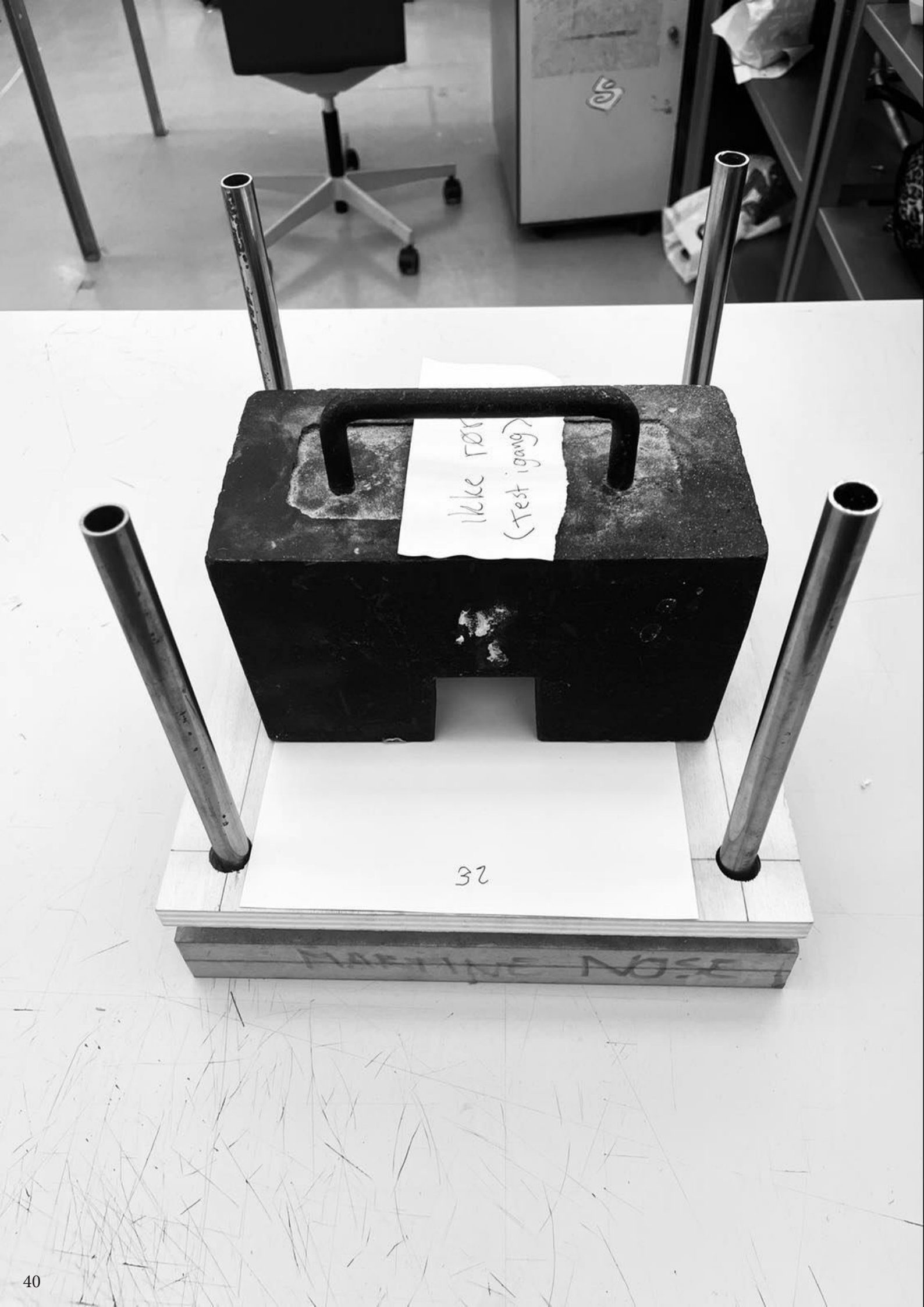


This diagram shows the weight of all my test cushions with the exact same dimentions (H: 5cm x L:20cm x W: 20cm) It shows which fibers and foams that are closest in weight. The reason weight is an important part of sustainability is: more material is produced, and the heavier the material transported, the more energy is required, which can lead to CO2 emissions and other negative environmental effects.

PRESS MARKS



This diagram shows whether there have been any press marks left after the press tests. Press marks can be both positive and negative. It can be positive because it means it works like memory foam and gives good comfort and ergonomics. It can be negative if the cushion doesn't maintain its shape, and you see the press marks left behind, making it look like the cushion is worn.


Ikke rør
(Test igang)
32

MY HOMEMADE TEST MACHINE 2

2.INDENTATION FORCE DEFLECTION (IFD)

To perform this test, you sould use a “chair test machine”. It’s perfomed by a robot pounding the cushion up and down. It simulates a user sitting down in a chair, and then standing up again – 80 thousands cycles.

After pounding, the cushion is re-measured. By comparing the initial firmness rating measured before pounding with the final firmness rating measured after pounding, an assessment of the durability of the cushion can be made. (22)

Instead of using a “chair test machine “, I made a homemade pressure machine, that pressed down with the 1:4 scale of an average human weight on my 1:4 scaled cushions. I added the pressure in, 10 seconds, 15 minutes, 3 hours, and 20 hours, and took measurements after each. This showed me the volume change with pressure over time.

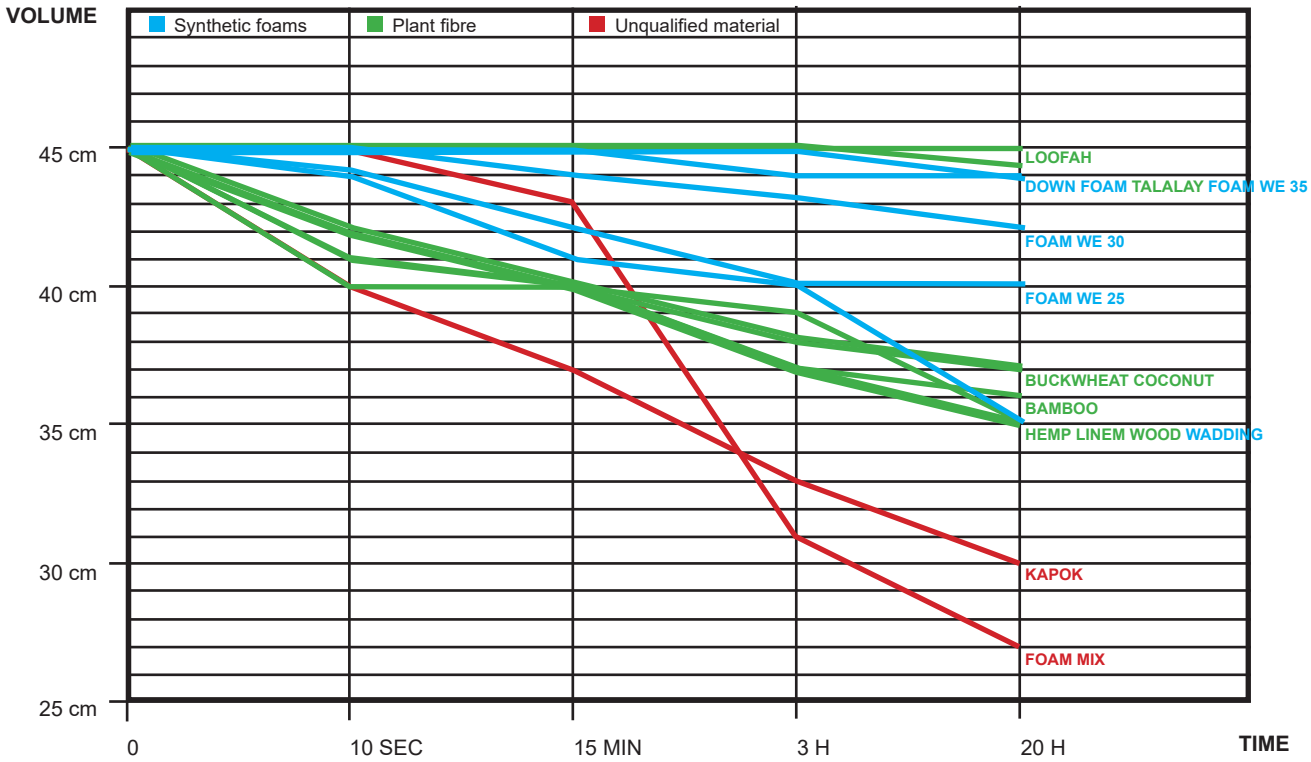
LOSE OF VOLUME	WITHOUT PRESS	WITH 20 KG PRESS	20 KG 10 SEC	TIME BOUNCH BACK	20 KG 15 MIN	TIME BOUNCH BACK	20 KG 3 H	TIME BOUNCH BACK	20 KG 20 H	TIME BOUNCH BACK
PLANT:										
HEMP	45 mm	21 mm	42 mm	1 sec	40 mm	1 sec	37 mm	2 sec	34 mm	2 sec
KAPOK	45 mm	22 mm	40 mm	1 sec	37 mm	1 sec	33 mm	2 sec	30 mm	2 sec
BAMBOO	45 mm	22 mm	43 mm	1 sec	39 mm	2 sec	35 mm	2 sec	31 mm	2 sec
LINEN	45 mm	28 mm	41 mm	1 sec	40 mm	1 sec	37 mm	1 sec	34 mm	2 sec
BUCKWHEAT	45 mm	27 mm	42 mm	0 sec	40 mm	0 sec	38 mm	0 sec	37 mm	0 sec
LOOFAH	45 mm	45 mm	45 mm	0 sec	45 mm	0 sec	45 mm	0 sec	45 mm	0 sec
COCONUT	45 mm	31 mm	42 mm	1 sec	40 mm	1 sec	38 mm	1 sec	37 mm	1 sec
WOOD	45 mm	34 mm	40 mm	1 sec	40 mm	2 sec	39 mm	1 sec	35 mm	1 sec
TALALAY	45 mm	13 mm	45 mm	1 sec	45 mm	1 sec	45 mm	1 sec	44 mm	1 sec
SYNTHETIC:										
WADDING	45 mm	15 mm	44 mm	1 sec	41 mm	1 sec	40 mm	1 sec	35 mm	1 sec
FOAM WE 25	45 mm	11 mm	44 mm	1 sec	42 mm	1 sec	40 mm	1 sec	40 mm	1 sec
FOAM WE 30	45 mm	15 mm	45 mm	1 sec	44 mm	1 sec	43 mm	10 sec	42 mm	10 sec
FOAM WE 35	45 mm	13 mm	45 mm	1 sec	45 mm	1 sec	44 mm	1 sec	44 mm	1 sec
FOAM REC	45 mm	30 mm	45 mm	1 sec	45 mm	1 sec	45 mm	1 sec	44 mm	1 sec
FOAM MIX	45 mm	24 mm	45 mm	1 sec	43 mm	1 sec	31 mm	0 sec	27 mm	0 sec

This chart shows the outcome data of my homemade test of: 2.INDENTATION FORCE DEFLECTION (IFD)

(22) https://www.satra.com/spotlight/article.php?id=485

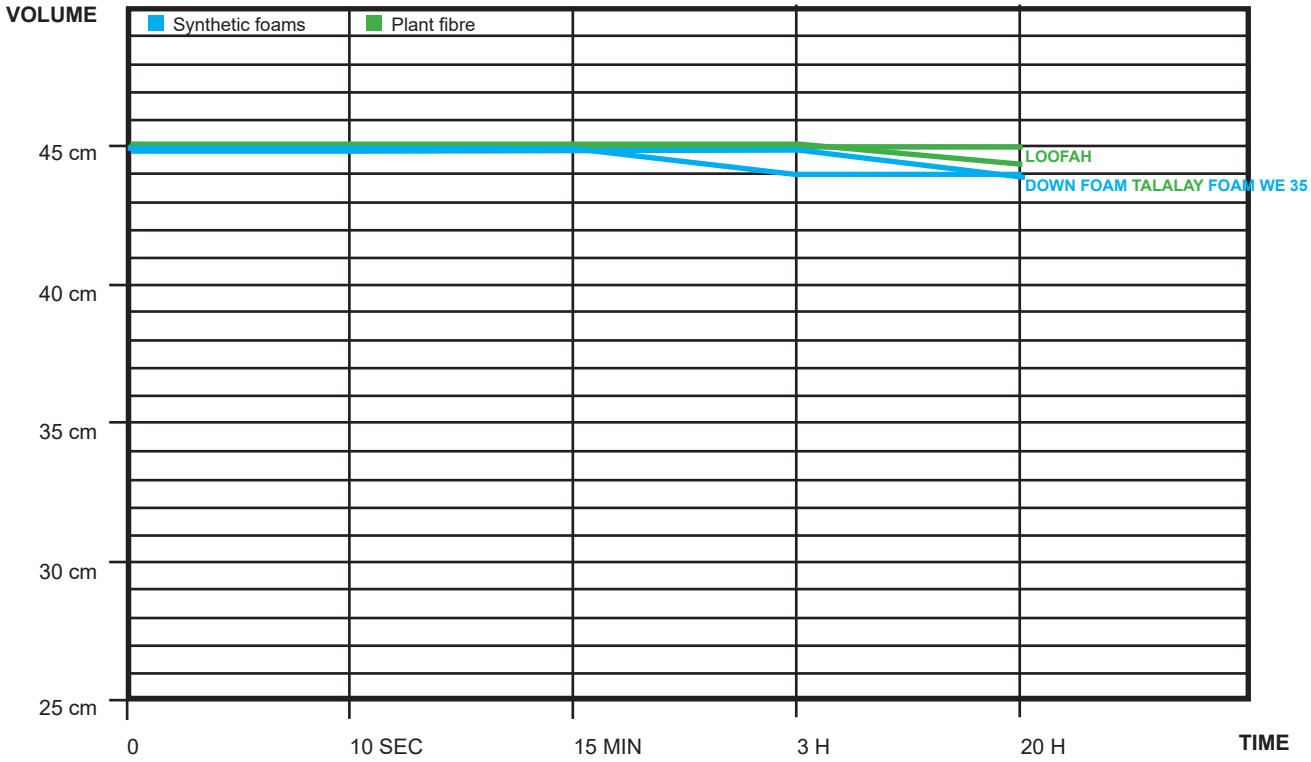
THE RESULTS

UNQUALIFIED MATERIALS



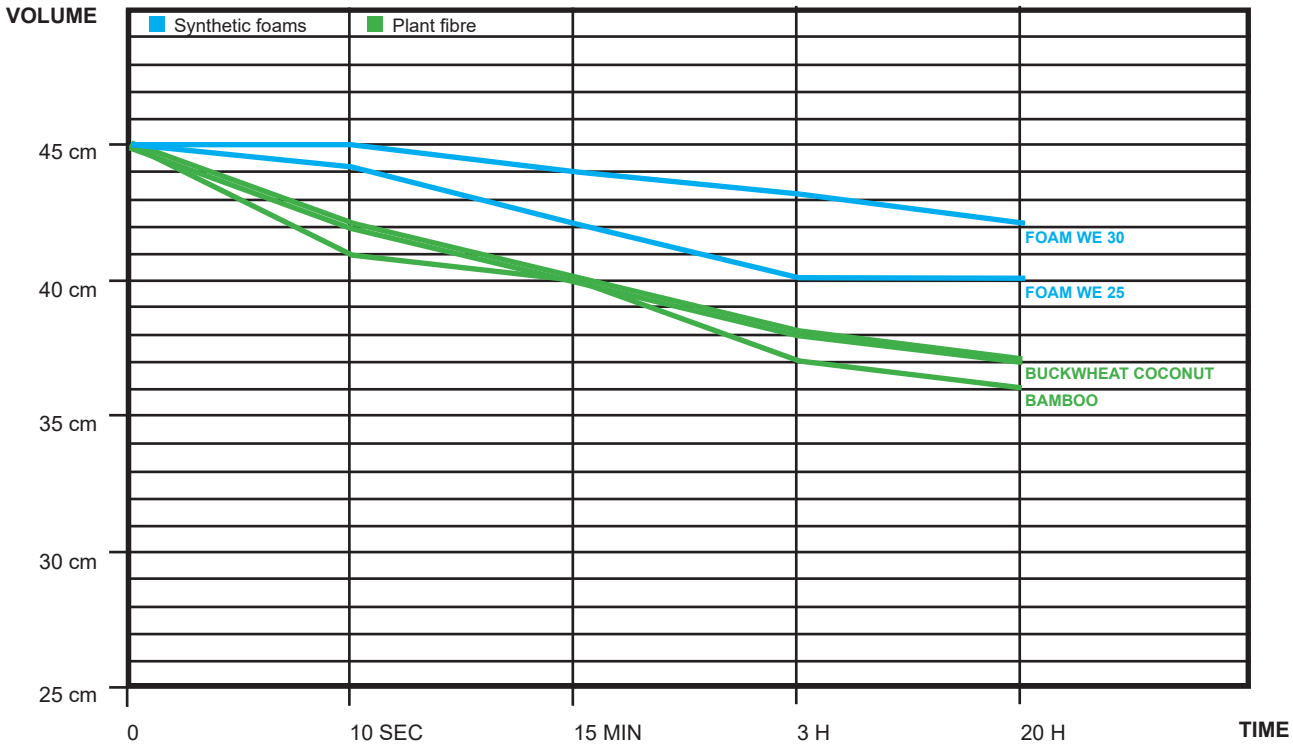
This diagram shows all the materials' volume change with pressure over time. Its also shows that "KAPOK" and "FOAM MIX" are unqualified materials for furniture cushions, because of their poor durability.

MATERIALS BEST FOR THE SEAT & BACK CUSHIONS



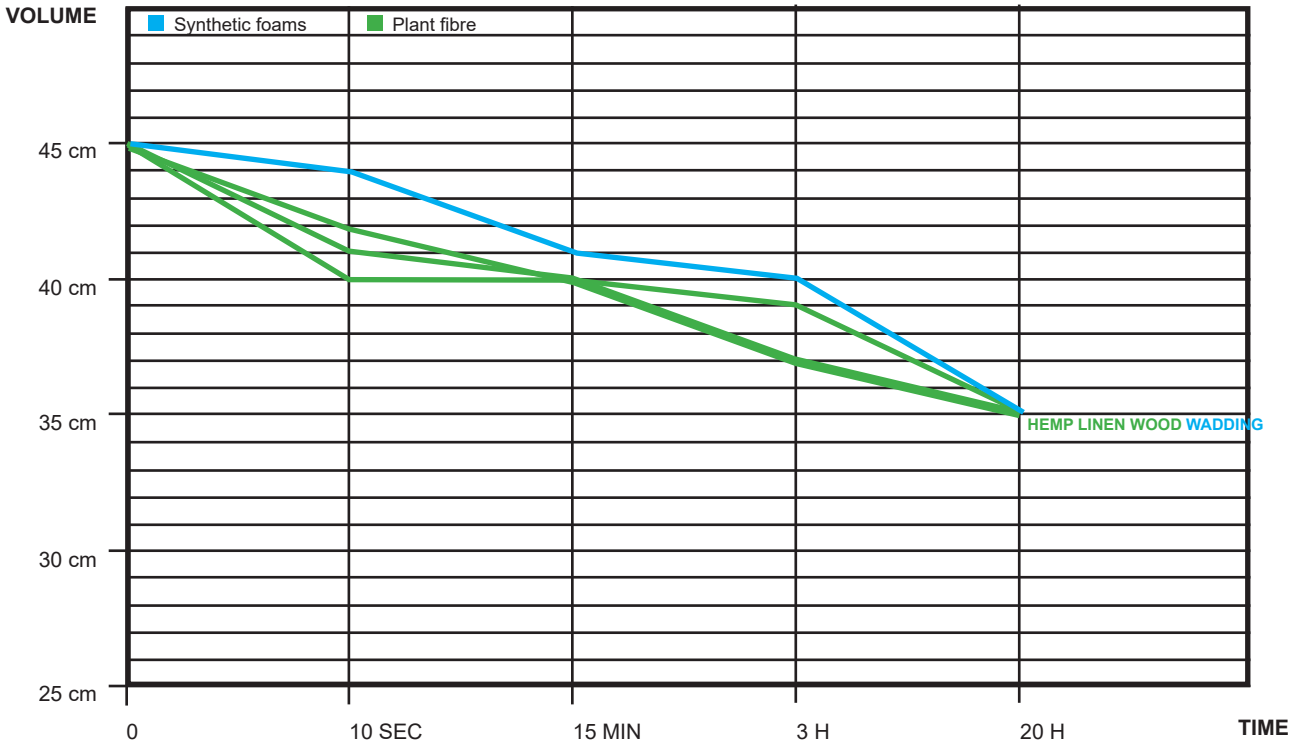
This diagram shows the synthetic foam "DOWN FOAM" and "FOAM WE 35" and the plant fibres "LOOFAH" and "TALALAY" are best qualified for the seat and back.

MATERIALS BEST FOR SOFTER BACK CUSHION



This diagram shows the synthetic foam “FOAM WE 30” and “FOAM WE 25“ and the plant fibres “BUCKWHEAT“,“COCONUT“, and “BAMBOO“ are best qualified for a softer back cushion.

MATERIALS BEST FOR PILLOWS & WADDING



This diagram shows the synthetic “WADDING“ and the plant fibres “HEMP“,“LINEN“, and “WOOD“ are best qualified for pillows and wadding.

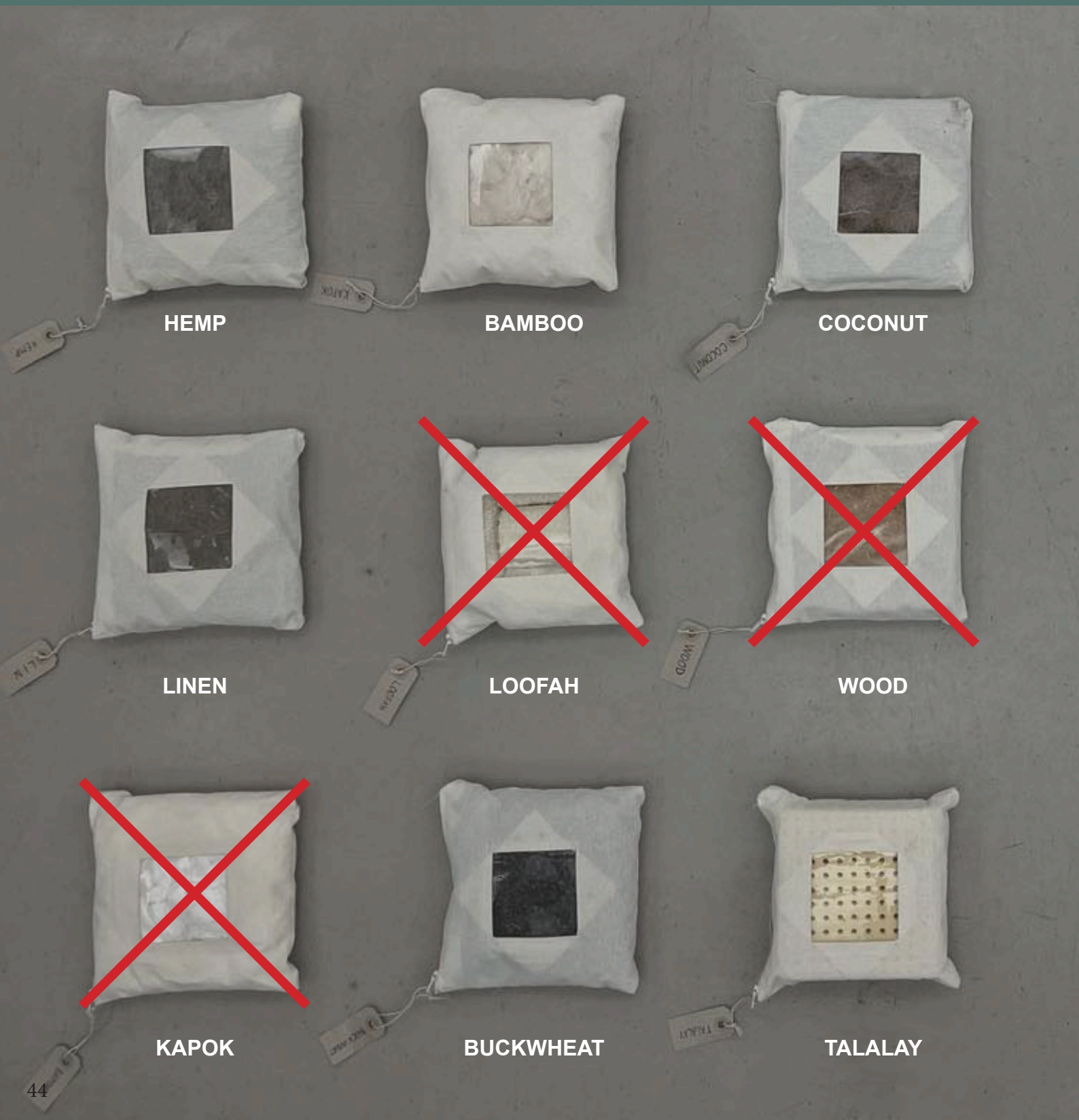
6 PLANT FIBRES

After I have:

1. Gathered desktop research of practical information about all the plant fibres and synthetic foams on their performance in relations to sustainability and maintenance of the sofa.

2. Done “durability” testing by using the: “1.INDENTATION LOAD DEFLECTION (ILD)” and “2.INDENTATION FORCE DEFLECTION (IFD)”

I have concluded that: LOOFAH, WOOD, and KAPOK are unqualified materials for sofa cushions, because of their test results. The test’s assessment of their durability show they either don’t maintain their shape over time or are too firm.



3 SYNTHETIC FOAMS

In the next phase of my “material exploration” im going to test the plant fibre’s and synthetic foams’ “EFFECT ON OUR SENSES”. Here im going to test it on users. When you are doing usertests, it’s an advantage that it does not take too long to get the most accurate answer before the test persons lose there patience. For this reason, im not going to test all the synthetic foams. I go further with:

- (WE 35) because it’s the most common furniture foam used in both seat and back cushions.
- (WADDING) because it’s used on top of the foam to make the cushion softer and give it more volume.
- (DOWN FOAM) because it’s downcycled foam used as harder stuffing.

The test results show that “FOAM MIX“ is unqualified, because it doesn’t maintain its shape over time. I also dont go further with (WE 30) and (WE 25) because they are not so commonly used in sofa cushions because they are softer.

EFFECT ON OUR SENSES

OUR SENSES' PART IN DESIGN

The materials used in design can have a significant impact on our senses, such as feeling, smell, and sound.

Sound is an important factor to consider. Different materials can produce different sounds when they are touched, moved, or used, which can add another dimension to the product's sensory experience.

Our sense of smell is strongly influenced by the materials around us. Different materials can interact with the receptors in our nose, resulting in a unique smell. Some odors can make us for example: pleasant, unpleasant, relaxed and agitated.

Our sense of feeling is complex and involves the physical properties of the material. For example, materials that are soft and smooth, can feel luxurious, calming and comforting to the touch, while materials that are rough, can feel unpleasant or even painful.

HOW I DID THE INTERVIEW

In my interviews I have talked to a diverse group of 10 people with different backgrounds and ages to help ensure a wider range of perspectives, and to improve the validity of the interview. The persons I have talked to are:

71 year old retired teacher / 27 year old nurse / 28 year old engineer / 40 year old insurance man / 25 year old industrial designer / 26 year old system-oriented designer / 37 year old teacher / 44 year old black smith / 24 year old interaction designer / 24 year old service designer

I have asked the people I interviewed specific questions to see all the unique sensorial qualities of the materials I'm testing. I have asked the following questions to find out:

What are the most and the least pleasing sensorial qualities of the materials?

How do people describe these materials?

What kind of emotions do they evoke? - such as surprise, love, hate, relaxation, etc.? (23)

(23) https://re.public.polimi.it/bitstream/11311/979536/1/MDD%20article.pdf

My homemade cushion covers, for the interview, so alle the fibres and foam, had the same impression as a real size sofa cushion, where you experience the material through a textile cover.

THE RESULTS

EXAMPLE ON HOW "COCONUT" EFFECTS OUR SENSE: FEELING (NEGATIV)

FEELING	**IS THE FEELING?** **FROM 1 TO 10 WERE:** **1: HARD / 10: SOFT**	**IS THE FEELING COMFORTING?** **FROM 1 TO 10 WERE:** **1: BAD / 10: GOOD**	**HOW WILL YOU DESCRIBE THE FEELING?** **(1 TO 3 WORDS)**
PLANT:			
COCONUT	**Answers:** 1 / 1 / 8 / 1 1 / 2 / 1 / 3 1 / 2 **Average:** 2,1 HARD <<	**Answers:** 5 / 3 / 4 / 1 3 / 3 / 2 / 5 4 / 4 **Average:** 3,4 BAD <<	**Answers:** Stable - hard – firm // Hard - stiff – even // Firm - crunchy - edge // Flat - unpleasant – fussy // Flat - rough - texture // Wheat // Bark // Compact // Patting - no pillow - hard // Hard - lumpy **Categories (Mentions something that are similar):** Hard: 9 times (hard – firm – hard – stiff - firm – flat - flat – rough - hard) **Repetitions:** 3x Hard // 2x Firm // 2x Flat

In this chart you see an example taken out of my findings from the interview. I learned from this study that the average person thinks "COCONUT" feels "HARD" and that the feeling with regards to comfort is "BAD". I also learn that the users think "COCONUT" has a feeling that people describe as: "HARD". Based on what the average person thinks I can conclude that "COCONUT is experienced as "NEGATIVE" in relation to the sense: FEELING

EXAMPLE ON HOW "FOAM REC" EFFECTS OUR SENSE: SMELL (NEUTRAL)

SMELL	**HOW DOES IT SMELL?** **FROM 1 TO 10 WERE:** **1: SMELL / 10. NO SMELL**	**IS THE SMELL?** **FROM 1 TO 10 WERE:** **1: BAD / 10: GOOD**	**WHAT DOES IT SMELL OF?** **(1 TO 3 WORDS)**
SYNTHETIC:			
FOAM REC	**Answers:** 6 / 7 / 6 / 2 5 / 6 / 5 / 3 5 / 4 **Average:** 4,9 SMELL<<	**Answers:** 8 / 8 / 4 / 2 5 / 4 / 3 / 4 4 / 5 **Average:** 4,7 BAD <<	**Answers:** Clean - pleasant - good // Neutral - sweet - pleasant // Boring - synthetic - nothing // Second hand - indoor - bad air // Chemical // Synthetic // Horse stable // Balloon // Gym - synthetic - textile // Nothing **Categories (Mentions something that are similar):** Pleasant: 6 times (Clean – pleasant – good – sweet – pleasant) // Synthetic: 4 times (synthetic – chemical – synthetic - synthetic) **Repetitions:** 2x Pleasant // 3x Synthetic

In this chart you see an example taken out of my findings from the interview. I learned from this study that the average person thinks "FOAM REC" has a "SMELL" and that the smell is "BAD". I also learn that the users think "FOAM REC" is smelling of:" PLEASANT" and "SYNTHETIC". Based on what the average person thinks I can conclude that "FOAM REC" is experienced as "NEUTRAL" in relation to the sense: SMELL.

EXAMPLE ON HOW “HEMP” EFFECTS OUR SENSE: SOUND (POSITIVE)

SOUND	**HOW DOES IT SOUND?** **FROM 1 TO 10 WERE:** **1: LOUD /** **10: LIGHT**	**IS THE SOUND** **FROM 1 TO 10 WERE:** **1: ANOYING /** **10: CALM**	**WHAT DOES IT SOUND LIKE?** **(1 TO 3 WORDS)**
PLANT:			
HEMP	**Answers:** 8 / 9 / 10 / 10 / 8 / 10 9 / 10 / 9 /8 **Average:** 9,1 >> LIGHT	**Answers:** 8 / 8 / 10 / 10 / 3 / 6 / 5 10 / 6 / 5 **Average:** 7,1 >> CALM	**Answers:** Pleasant - calm – quietly // Crunchy - silent - nothing // Crunchy - natural – lawn // Silent // Quiet - mute – light // Nothing // Silent // Nothing //Muffle - low – weak // Crunchy / Soft **Categories (Mentions something that are similar):** Pleasant: 2 times (Pleasant – calm) // Silent: 10 (Quietly – silent – nothing – silent - Quiet – mute - light - nothing – silent – nothing – low weak) **Repetitions:** 2x Quiet // 3x Silent // 3x Nothing

In this chart you see an example taken out of my findings from the interview. I learned from this study that the average person thinks “HEMP” has a sound that is “LIGHT” and “CALM”. I also learn that the users think “HEMP” has a sound that people describe as: “PLEASANT”, “SILENT“, and “NOTHING“. Based on what the average person thinks I can conclude that “HEMP“ is experienced as “POSITIVE“ in relation to the sense: SOUND.

FINAL OUTCOME OF FIBRES’ & FOAMS’ “EFFECT ON OUR SENSES”

SENSES	**SMELL**	**SOUND**	**FELLING**
PLANT:			
HEMP			
BAMBOO			
LIN			
BUCKWHEAT			
COCONUT			
TALALAY			
SYNTHETIC:			
WADDING			
FOAM WE 35			
FOAM REC			

After collecting all the answers from the interview I have calculated and concluded what the average person thinks of fibres and foams in relation to our senses. I have shown all my findings of my study “EFFECT ON OUR SENSES” in this chart and divided it into 3 color codes to make it easier to see what people experience as: “POSITIVE” (green), “NEUTRAL” (yellow), “NEGATIVE” (red).

To see the outcome and the answers conducted of the interview I refer to Appendix C

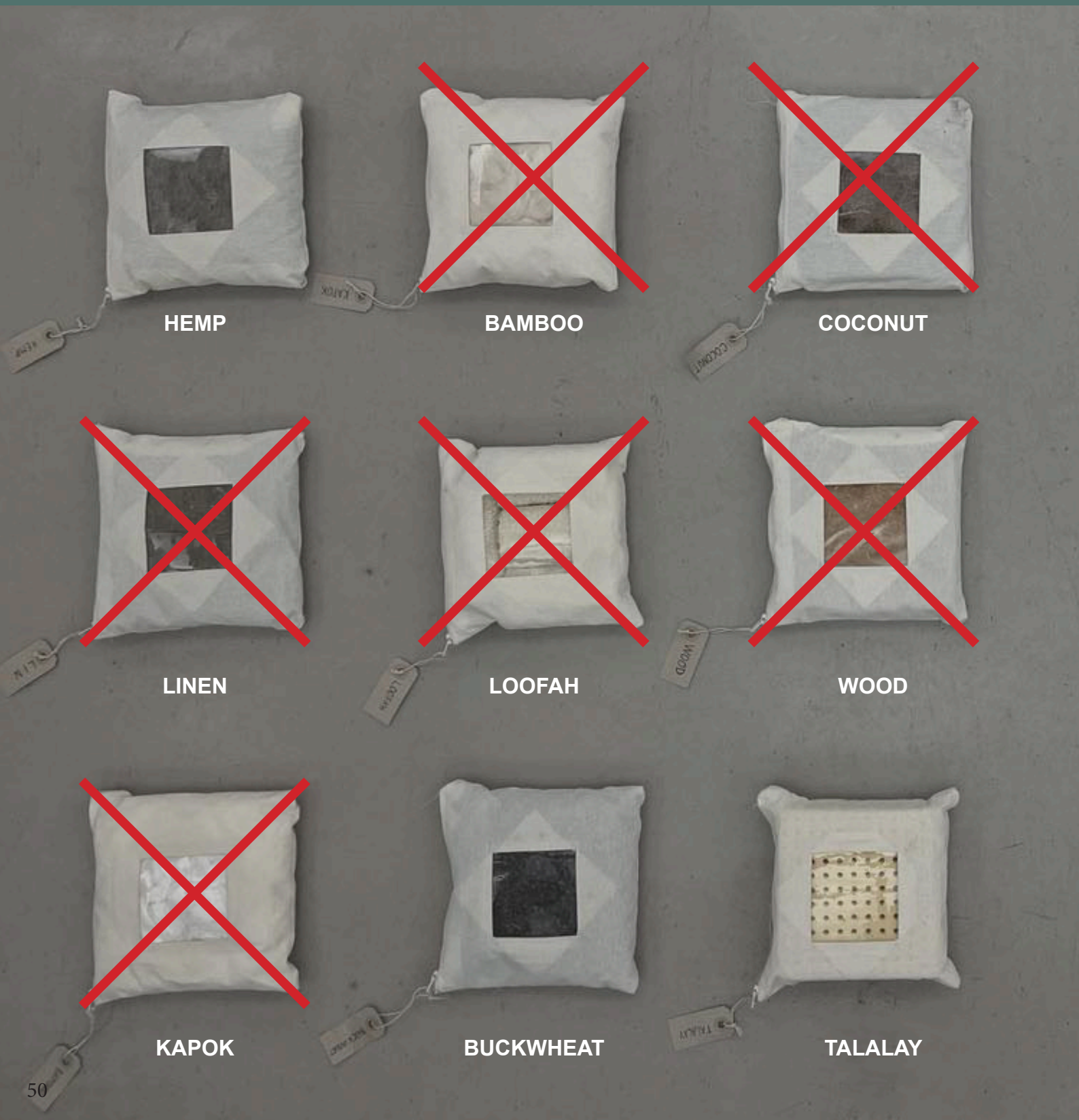
3 PLANT FIBRES

After i have gathered information about fibres' and foams' "EFFECT ON OUR SENSES" by interveiwing 10 persons:

I have chosen to continue working with the 3 plant fibres: (HEMP, BUCKWHEAT, and TALALAY)

And i have conclude to take away the 3 plant fibres: (BAMBOO, COCONUT and LINEN)

The reason I took away "BAMBOO", "COCONUT" and "LINEN" is because i could conclude after the result in "EFFECT ON OUR SENSES" that they are unqualifed materials, because people prefered the sensory experience of "HEMP","BUCKWHEAT" and "TALALAY".



1 SYNTHETIC FOAM

In the next phase of my “material exploration” I’m going to test the plant fibres’ and synthetic foams’ comfort in full size 1:1 scaled sofa coshions in a usertest with 10 test persons.

Because “WE 35” is the most recommended foam to use for both seat and back cushions in a sofa, I chose to only go further with that as a reference synthetic foam in the last test and take away “WADDING” and “DOWN FOAM”.

COMFORT TEST 1:1 CUSHIONS

In this last phase of my material exploration im going to test the comfort of my last 3 plant fibres (HEMP, BUCKWHEAT, and TALALAY) and the synthetic referance foam (WE35).

The way I'm doing the test is that i have used a regular sofa construction with regular flexibility, as a base for the test. I have then tested the fibres and foams in a test cushion with half of its regular volume (a normal cushion has a hight of around 18 cm, for this test i have used hight of 9 cm) I have done this because of two reasons:

1. To test less volume, because less volume means less weight and that is better for the environment, as previously mentioned: because more material is produced, and heavier material transported, the more energy is required, which can lead to CO2 emissions and other negative environmental effects.

2. I also conclude it's easier to compare the comfort if the cushions have less volume. (easier to define as a user whether it's firm or soft)

I have done the testing by first combining 10 differnt combinations of plant fibre and selected 4 combinations that I conclude are best qualified and give best comfort.

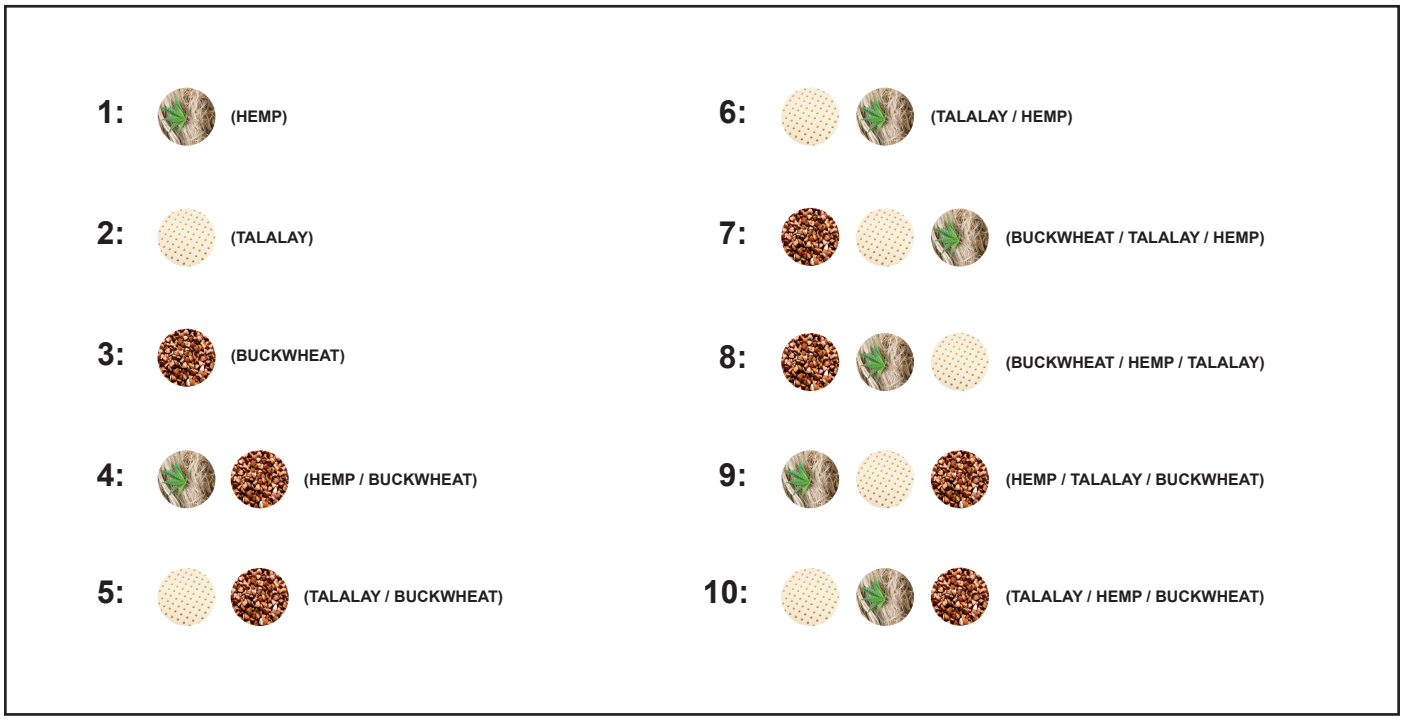
I then have 10 users from my class try out the 4 combinations of plant fibres + WE35 synthetic reference foam (without knowing what material was in the cushion they tested). They had to sit for a short time (1 min in each cushion) and then selected the 3 combinations they liked most with regards to comfort. After this test I could conclude from the average in the test result which 3 combinations of plant fibre the users liked most in relation to comfort. To see the entire outcome and the answers conducted of my usertest I refer to Appendix D)

Then I did a sitting test myself, where i watched tv in each of the combinations for a duration of 1 hour. After this test I could conclude the best area of use for the 3 combinations.

Here you see my test setup: a regular sofa construction with regular flexibility and 3 of my test cushions.

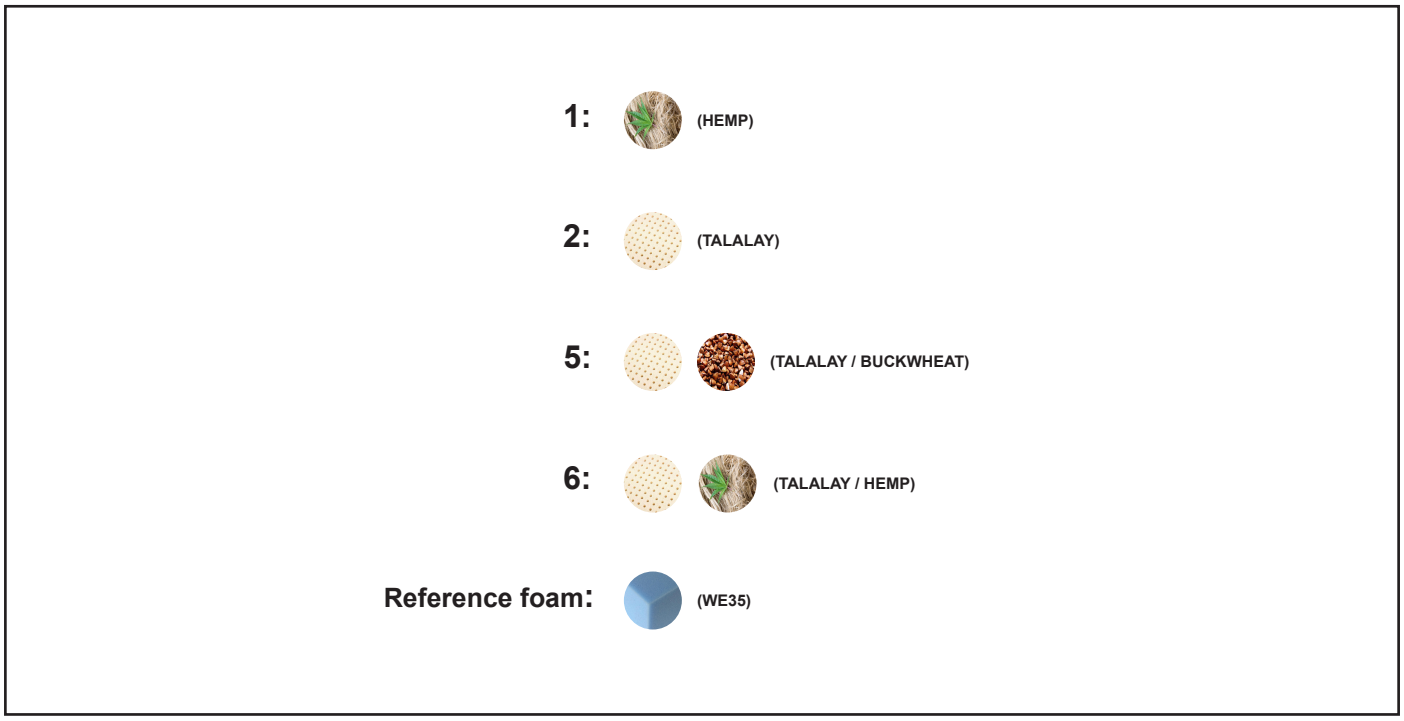
THE RESULTS

TEST 10 COMBINATIONS



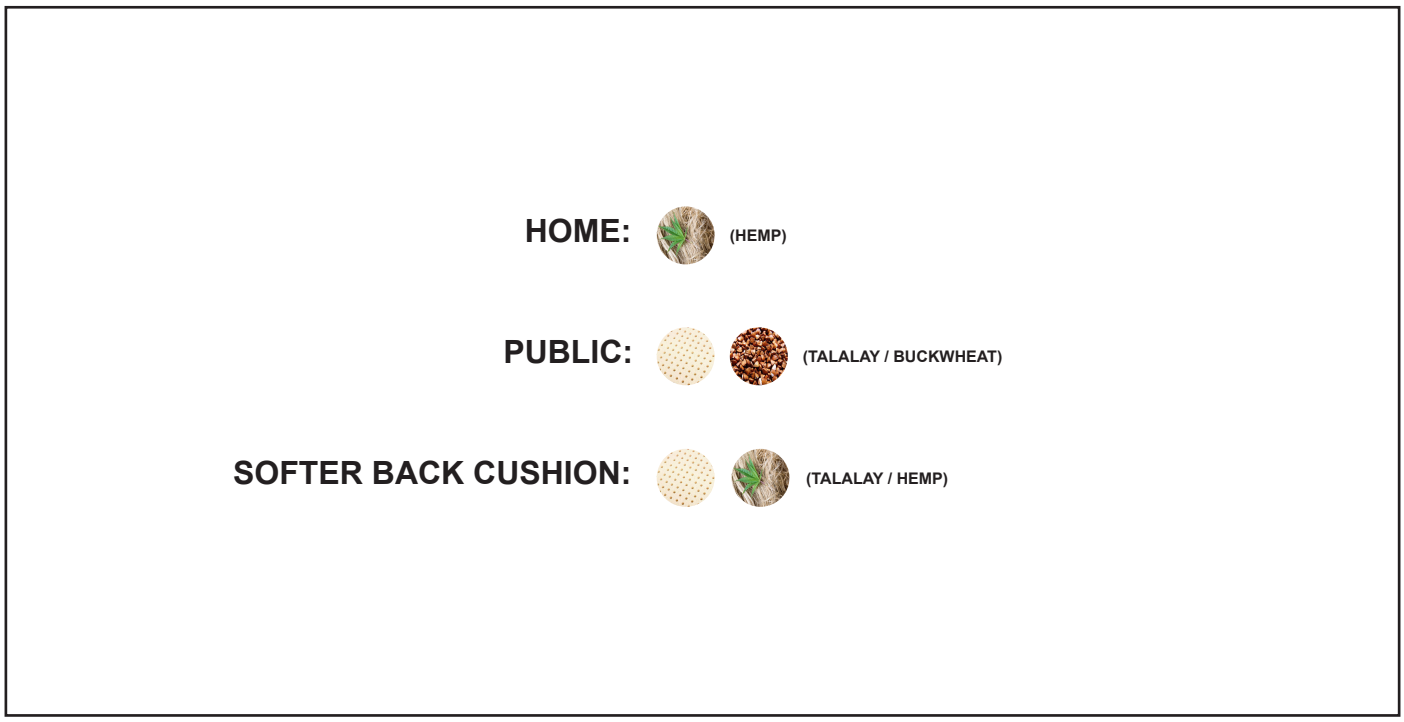
In this chart you see the 10 different combinations of plant fibres I tested myself in my full sized test cushions. I learned by combining fibres in differnt ways, that some fibres are best in the base layer of the cushion like “TALALAY“ and som are best in the top layer like “BUCKWHEAT“ and do not work the other way around. After this test I chose my 4 favorits (the ones seen in the next chart) which I concluded gave the most comfort.

TEST 5 COMBINATIONS WITH USERS (SIT FOR A SHORT TIME 1 MIN)



In this chart you see the 4 different combinations of plant fibres + 1 foam, which I tested on 10 users. Each one told me which 3 they liked most (without knowing what material was in the cushion they tested) with relation to comfort in a shot period of time (1min). The 3 plant fibre combinations getting the highest score are shown in the next chart:

TEST 3 COMBINATIONS (SIT FOR A LONG TIME 1 HOUR) & FIND THEIR AREA OF USE



In this chart you see the 3 final plant fibre combinations that got the highest result in comfort, conducted by the users. To find the best area of use for the 3 combinations, I tested them, by sitting in each combination myself for 1 hour while watching TV. After this I had an indication of what area of use was suited best for each combination:

1. “HEMP“ was the best one for long periods of time sitting, which you require of a sofa in the home. It gave good firm support, without being to soft. So my final conclusion is that “HEMP“‘s best area of use would be: a sofa for the home.

2. “TALALAY / BUCKWHEAT“ was a harder sitting, which you require of a sofa for a work place. You cannot sit too comfortably to be efficient. It gives good comfort because “BUCKWHEAT” works like memory foam, and is very inter-resting and fun to sit on, but is still a little hard. So my final conclusion is that “TALALAY / BUCKWHEAT“‘s best area of use would be: a sofa for the public.

3. “TALALAY / HEMP” was very good to sit on in the begining, however, after a while it was too soft in the seat, but not in the back, so I got a little tired in my body. So my final conclusion is that “TALALAY / HEMP” doesn’t have an area of use, but it can be used if you want a softer back cushion.

CHAPTER 3 CONCLUSION

MATERIAL EXPLORATION RESULT

My material exploration resulted in 3 material proposals of plant fibre combinations to replace synthetic foams.

These material proposals have the area of use:
- A sofa for home (HEMP)
- A sofa for public (TALALAY / BUCKWHEAT)

If the sofa in one of the areas of use needs a softer back, this material exploration also showed a solution to:
- A softer back cushion (TALALAY / HEMP)

NEXT STEP

The next step is to make the sofa cushions in a working prototype. Her i went to Eddie King, a professional furniture upholsterer in Oslo, where i showed him my findings from the “MATERIAL and DESIGN EXPLORATION”. In material driven design (MMD) you do the material and design explorations synchronously, so in this conclusion I’m done with the design exploration, which you can read about in the next pages.

WORKING PROTOTYPES

In the “DESIGN EXPLORATION” I chose to design a sofa for the area of use: home. So me and Eddie discussed my material proposal “HEMP“.

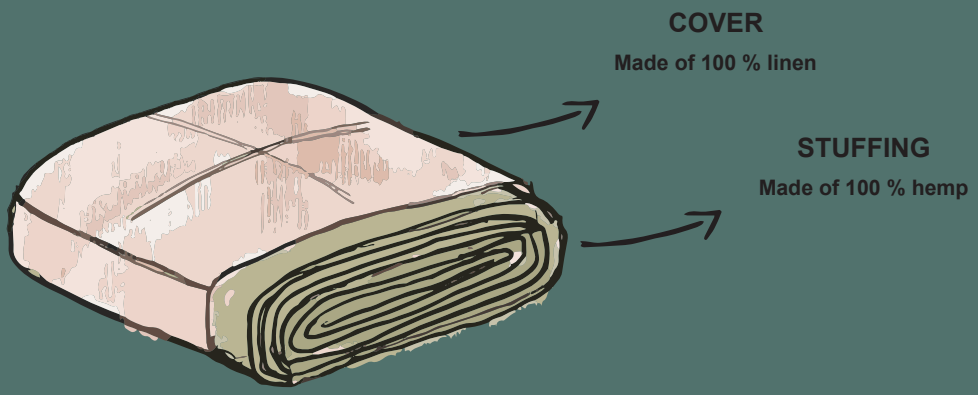
He said that, with his 40 years of experience in upholstry, he didn’t think “HEMP“ alone would work. He thought it would lose its volume over time. He recommended making a core of “WOOD WOOL” and use the “HEMP“ only as the wadding around.

Because of Eddie´s many years of insights into upholstering furniture, I deduce his opinion and feedback as being valuable and trusthworty. I decided to go further with him making 3 working prototypes: the one he recommended with WOOD WOOL” and “HEMP“, the other one my test result suggested with only “HEMP“, and the third one with synthetic “FOAM WE35” and “WADDING” as reference. Thise 3 working prototype cushions will later in this project be tested in a final usertest.

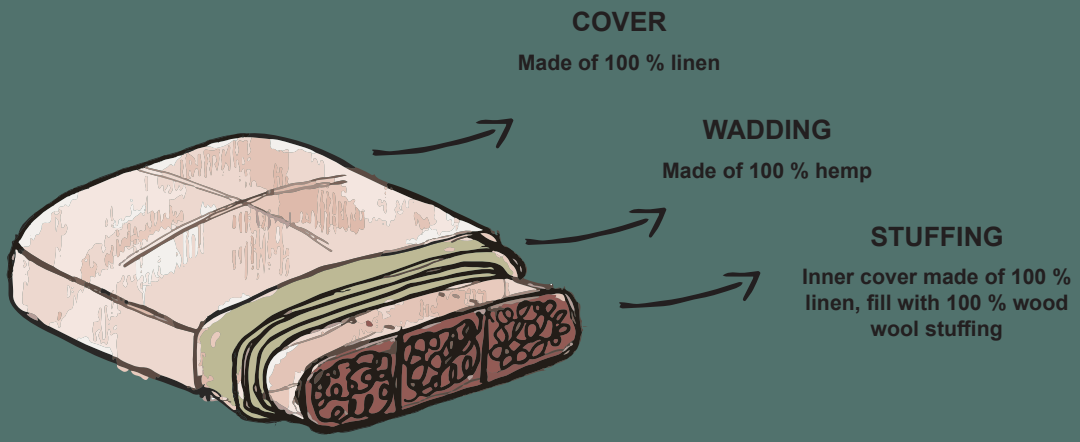
Here you see the inner cover in its making, with hemp on the top

Here you see the 100 % linen textile used as the cushion’s cover

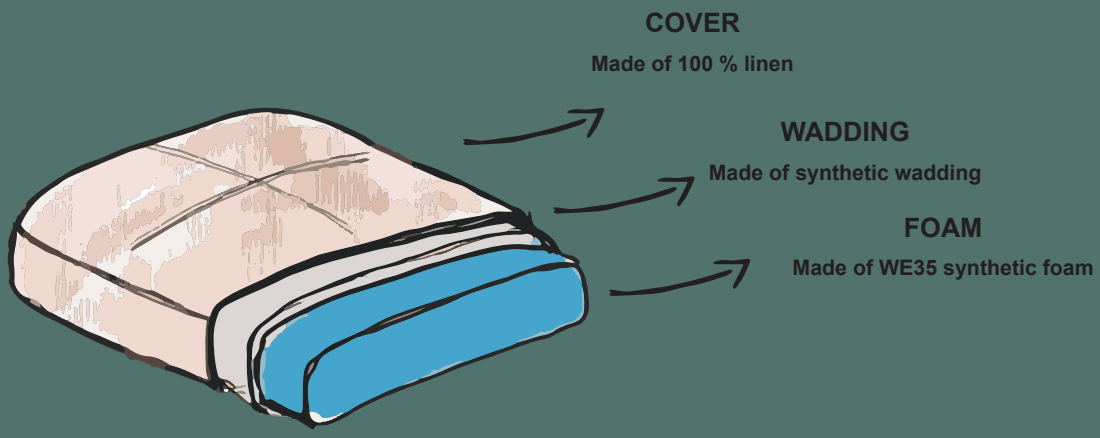
1: TEST RESULT'S CUSHION (HEMP)



2: EDDIE'S CUSHION (HEMP / WOOD WOOL)

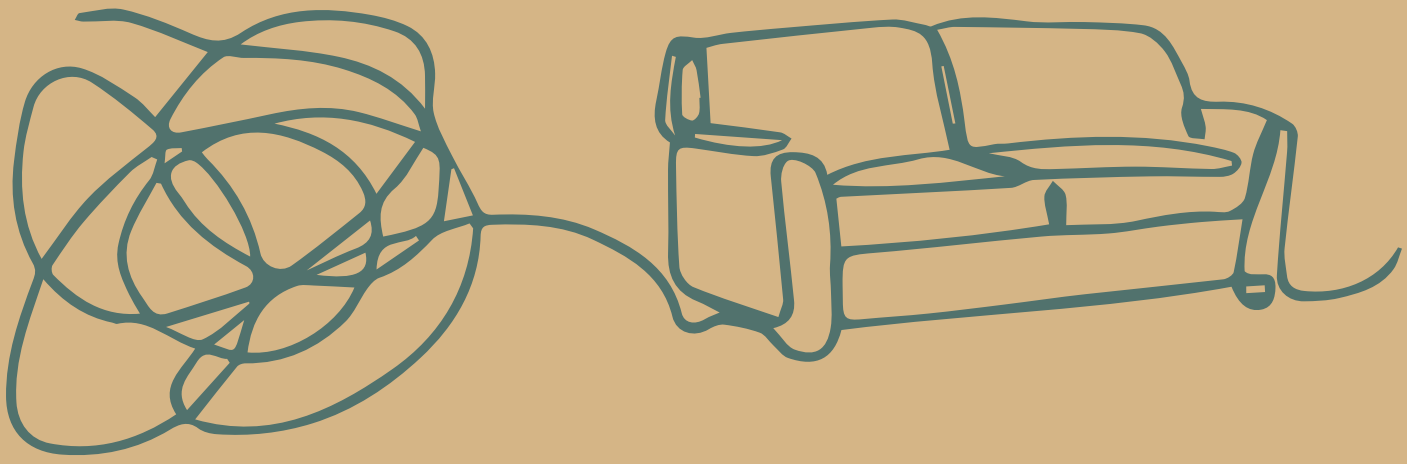


3: REFERENCE CUSHION (SYNTHETIC WADDING / WE35 FOAM)



CHAPTER 4

DESIGN EXPLORATION



MY DESIGN JOURNEY

In this design exploration you can read about how I ended up with my concept of a modern take on what a sustainable sofa should look like today. This exploration is going to consist of 3 steps:

STEP 1:

How I have looked into different ways of flexibility in construction of a sofa.

STEP 2:

How I have looked into what leading sustainable furniture companies have of sustainable design criteria, and made sustainable design direction & criteria for my ideation, with 3 directions and 3 criteria.

STEP 3:

How I have have made 3 ideations of my 3 directions from 3 criteria, and a conclusion on my final choosing of concept.

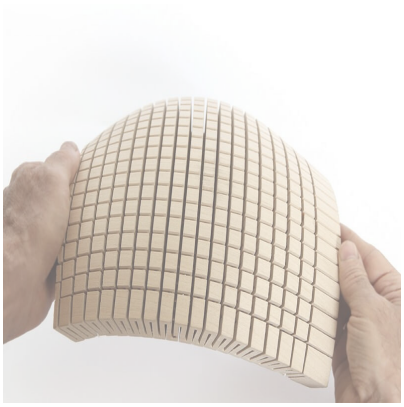
FLEXIBILITY IN CONSTRUCTION

Here you see many ways of implementing flexibility in a sofa construction. A flexible construction is important in a sofa for several reasons.

1: Comfort: Furniture with flexibility provides a good comfort. Flexibility in a sofa offers a supportive and resilient surface that can cushion your body weight and provide a comfortable place to sit or lie down.

2. Support: a flexible construction can provide support in key areas of a piece of furniture, such as the seat and backrest. This can help to reduce pressure points and prevent discomfort during long periods of sitting.

WEBBING



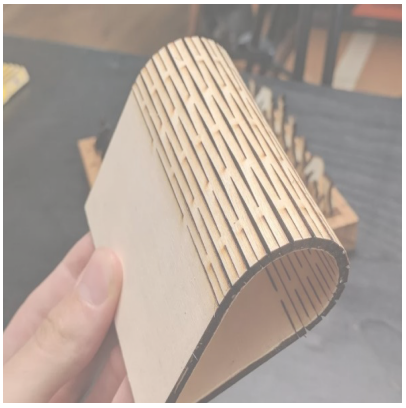
3D WOOD

SYNTHETIC RIBBONS

HEMP RIBBONS

ERGONOMICS

3D PATTERN



2D WOOD

SLATS

TEXTILE

3: Durability: a flexible construction can help withstand repeated use, so the sofa lasts longer

4: Shape retention: flexibility can help furniture retain its shape over time. This is especially important for upholstered furniture, which can become misshapen or saggy without proper support.

5: Sustainability: if the sofa has a flexible construction it needs less volume (plant fibres) in the cushions. Less weight is better for the environment, as previously mentioned.

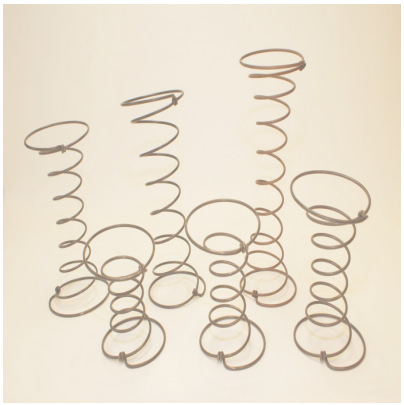
Collage of flexibility in construction

LEATHER

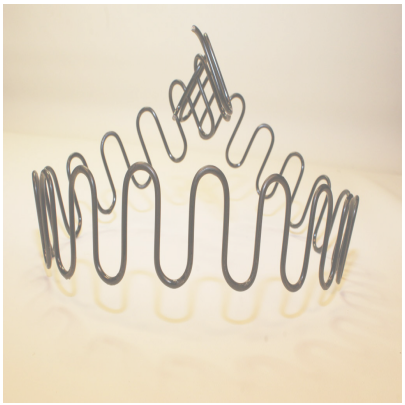
3D KNITTING

ROPE

2D PATTERN



COIL SPRING



SINUOUS SPRING

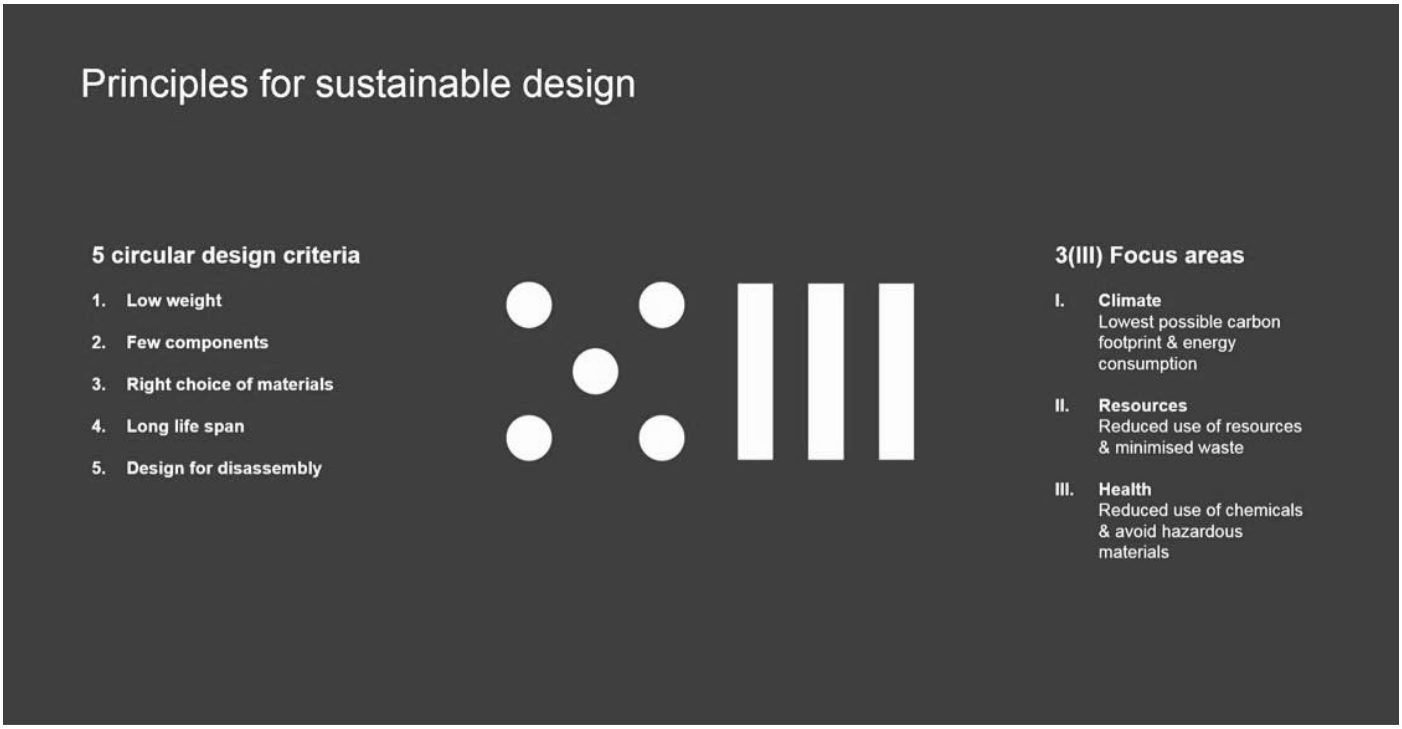
WIRE

WEBBING

BRAID

DESIGN DIRECTIONS & CRITERIA

Before starting my ideation for a sustainable sofa, I have looked into what leading sustainable furniture companies have of sustainable design criteria, to better understand what is needed of a sustainable sofa today. Here I have looked at the Norwegian company Flokk, and the Danish company TAKT:



Here you see the inner cover in its making, with hemp on the top

Flokk is a Norwegian furniture company, that designs and produces furniture for the public with sustainable materials and manufacturing processes. The company follows 5 principles of sustainable design to ensure that their products are sustainable:

1. Low weight: building better products with fewer resources

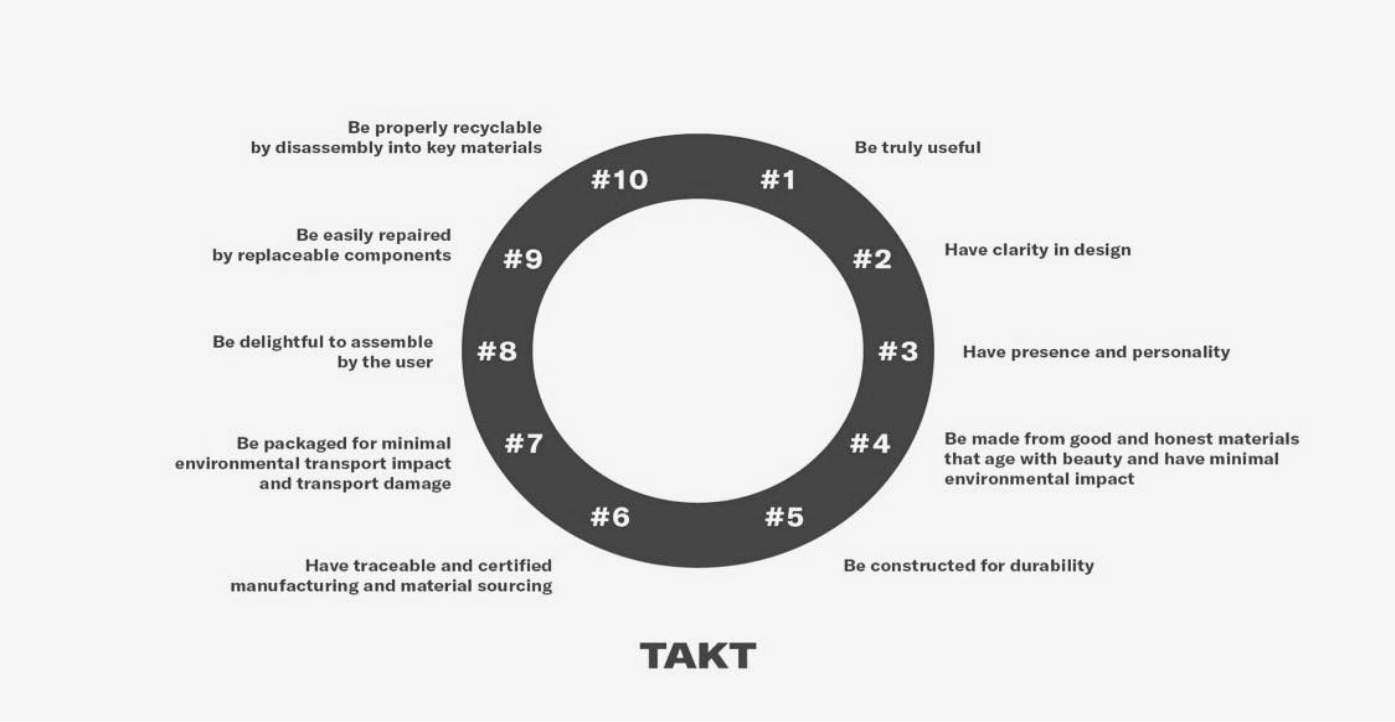
2. Fewer components: makes smarter functions and manufacture easier

3. Right choice of materials: we choose recycled and recyclable sources.

4. Long lifespan: we build our furniture to last

5. Designed for disassembly our products can be repaired, reused and recycled.

(24) https://www.flokk.com/global/about-us/sustainability/our-promise



Here you see the inner cover in its making, with hemp on the top

TAKT is a Danish furniture company that designs and produces furniture for the home with sustainable materials and manufacturing processes. The company follow 10 Eco System Design Principles, here are the 5 I see as most important:

1. Be truly useful: before creating another object, think about whether it's really necessary ?

2. Be made from good, environmental and honest materials that age with beauty.

3. Be constructed for durability: good design must be able to withstand the use over time.

4. Be packaged for minimal environmental transport impact.

5. Be easily repaired by replaceable components, by ordering a new part.

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(25) https://taktcph.com/live-sustainably/design-principles/

DESIGN DIRECTIONS & CRITERIA

After studying and getting inspired by what criteria Flokk and TAKT are using, to ensure a long lasting sustanable design. I have chosen: “3 DESIGN DIRECTIONS” and “3 CRITERIA” for my ideation process:

Here you see my 3 design directions

1: LIGHT: a sofa that has no stuffing, but only a flexible construction, that gives it comfort.

2: HYBRID: a sofa that is a hybríd of less stuffing and a flexible construction, that gives it comfort.

3. VOLUMINOUS: a sofa that has the normal amount of stuffing, and looks voluminous.

3 CRITERIA:

LOW WEIGHT
FEW COMPONENTS
DISASSEMBLY

Here you see my 3 design criterias

1: LOW WEIGHT: fewer resources from production and transportation.

2. FEW COMPONENTS: makes manufacturing easier, more delightfull to assemble by the user.

3. DISASSEMBLY: products that can be flat-packed, repaired, reused and recycled.

LIGHT FURNITURE

To start my ideation phase of “LIGHT”, I made a moodboard, with furniture that can be defined as “LIGHT”: a sofa that has no stuffing, but only a flexible construction that gives it comfort.

SPACIOUS

ERGONOMIC

FLEXIBLE

SCULPTURAL

ONE MATERIAL

Collage of LIGHT FURNITURE

SIMPLE

BOTH OUTDOOR & INDOOR

FEW COMPONENTS

PLAYFULL

EASY TO FLAT PACK

GOOD COMFORT

IDEATION 1

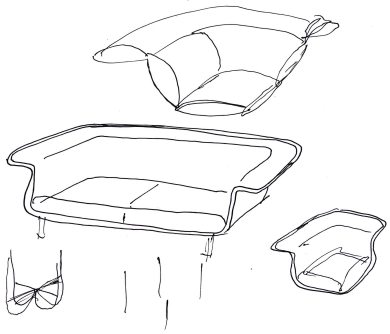
Here you see my “IDEATION 1” of “LIGHT FURNITURES“. I’m looking for concepts with a flexible construction that gives good comfort. I’m also looking for concepts that meet my 3 sustainable design criteria:

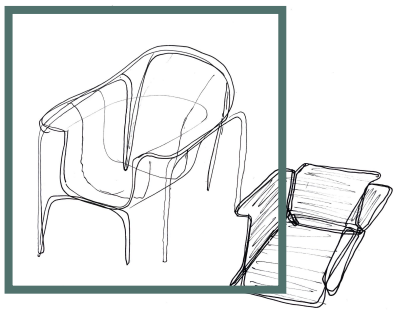
1: LOW WEIGHT: fewer resources from production and transportation.

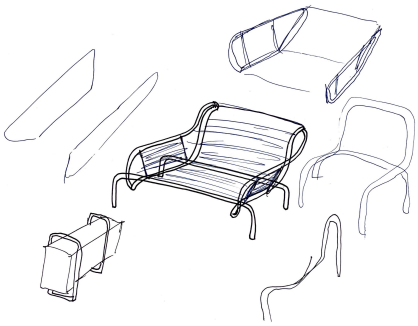
2. FEW COMPONENTS: makes manufacture easier, more delightfull to assemble by the user.

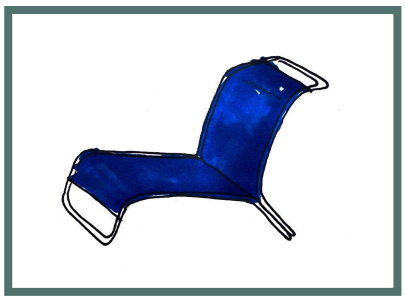
3. DISASSEMBLY: products that can be flat-packed, repaired, reused and recycled.

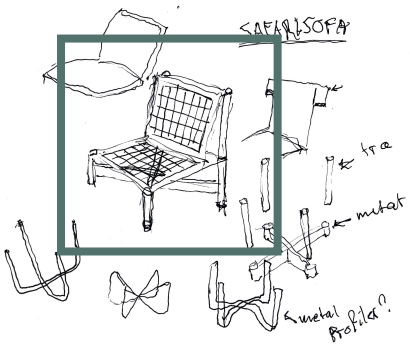
(The 9 sketches marked with green are the ones I selected to work further on in “IDEATION 2”)










SAFARISOFA
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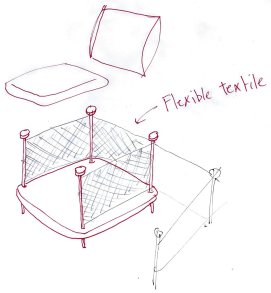
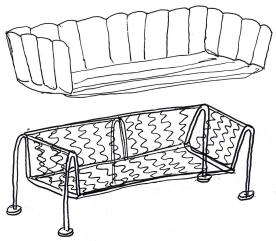
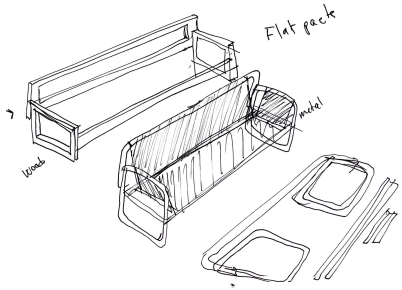
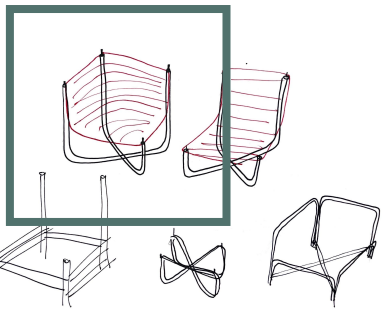
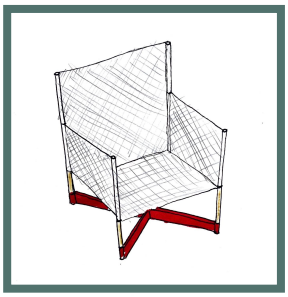
metal profil?

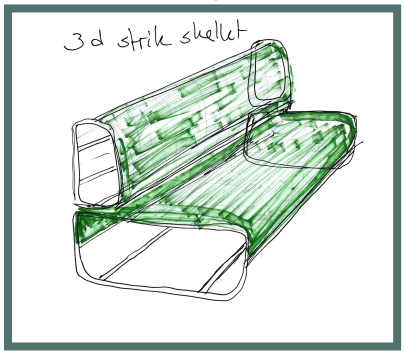

Flexible textile

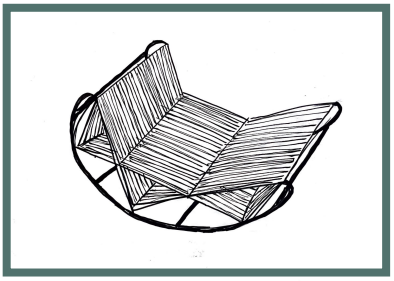


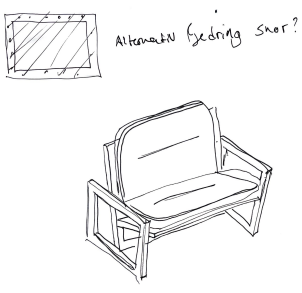

Flat pack
metal
wood






3d strik skellet




Alternativ fjedring snor?

IDEATION 2

Here you see my “IDEATION 2” of “LIGHT FURNITURES“ were I took the 9 chosen sketches from “IDEATION 1“ and made them into more defined vectorized sketches, and further decribe each of the 9 concepts’ qualities.

(To see the sketches in full size with descriptions of their qualities I refer to appendix E)

To choose a concept, I made an assessment form, where I evaluated the 9 concepts against my 3 design criteria: “LOW WEIGHT”, “FEW COMPONENTS”, and “DISASSEMBLY”.

(The concept marked with green got the highest rating in the assessment form, to see the assessment form, I refer you to Appendix E)

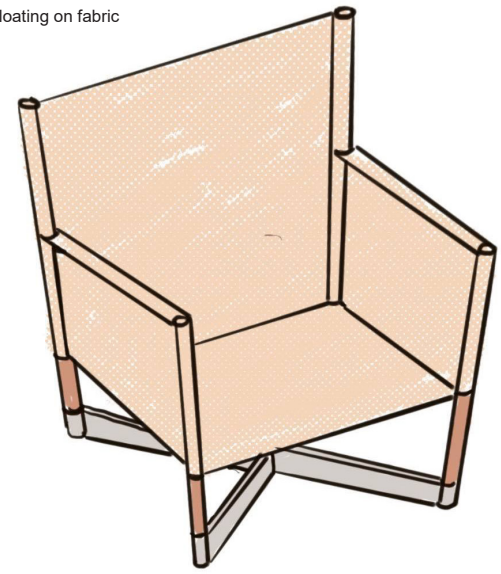
CONCEPT INFO:

Furniture type: Lounge chair

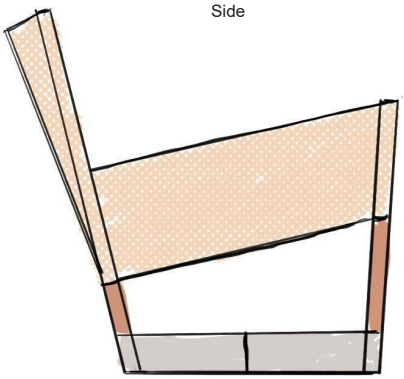
Material: Stainless stell and fabric

Ergonomic: Body contact with construction in the corners

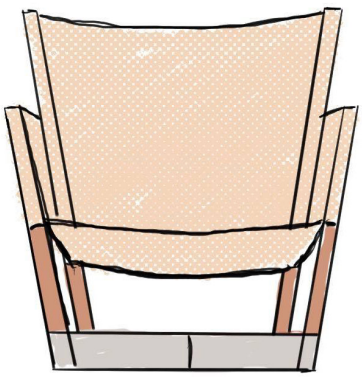
Flexibility: Bouncing and floating on fabric



Side



Front



6 Circular desingn criteria:

1. Low weight: Yes

2. Few componements: Yes

3. Right choise of materials: Good

4. Long life span: Looks okay durable

5. Design for disassembly: Yes

6. **Small in packaging size:** Very small

Scale 1:10

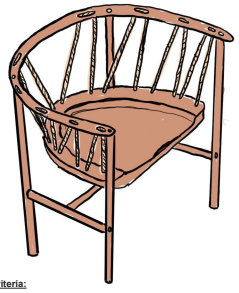
CONCEPT INFO:

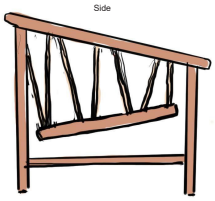
Furniture type: Moving chair

Material: Wood and rope

Ergonomic: Kind of hard, but a good chair if you "cant sit still" the chair is always in movement

Flexibility: Moving form side to side





Side

Front

Scale 1:10

6 Circular desingn criteria:

1. Low weight: No

2. Few componements: Semi

3. Right choise of materials: Good

4. Long life span: Yes

5. Design for disassembly: Semi

6. **Small in packaging size:** Semi

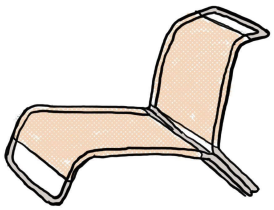
CONCEPT INFO:

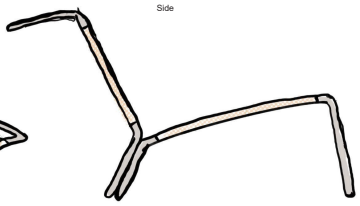
Furniture type: Lounge and regular chair after which direction you turn it

Material: Stainless stell and fabric

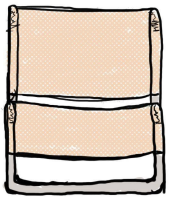
Ergonomic: Body contact with construction in the sides

Flexibility: Bouncing and floating on fabric





Side



Front

Scale 1:10

6 Circular desingn criteria:

1. Low weight: Yes

2. Few componements: Yes

3. Right choise of materials: Good

4. Long life span: Looks okay durable

5. Design for disassembly: Yes

6. **Small in packaging size:** Semi

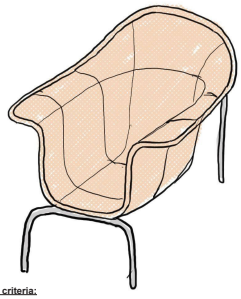
CONCEPT INFO:

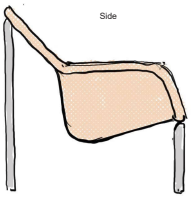
Furniture type: Lounge chair

Material: Aluminium and fabric

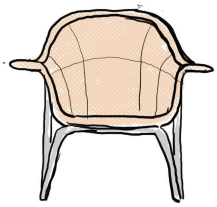
Ergonomic: Body contact with construction in front and back

Flexibility: Bouncing. and floating on fabric





Side



Front

Scale 1:10

6 Circular desingn criteria:

1. Low weight: Yes

2. Few componements: Yes

3. Right choise of materials: Good

4. Long life span: Semi

5. Design for disassembly: Semi

6. **Small in packaging size:** Semi

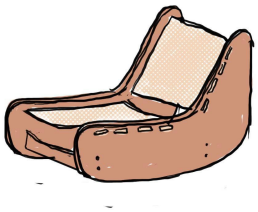
CONCEPT INFO:

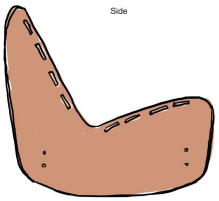
Furniture type: Rocking chair

Material: Wood and fabric

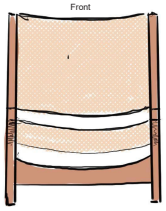
Ergonomic: Body contact with construction in the sides

Flexibility: Rocking, bouncing. and floating on fabric





Side



Front

Scale 1:10

6 Circular desingn criteria:

1. Low weight: Semi

2. Few componements: Yes

3. Right choise of materials: Good

4. Long life span: Yes

5. Design for disassembly: Yes

6. **Small in packaging size:** Semi

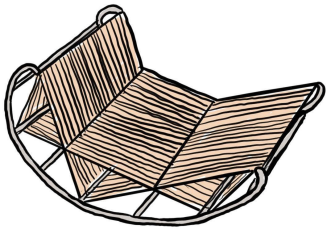
CONCEPT INFO:

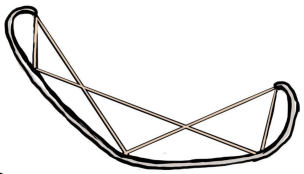
Furniture type: Rocking chair

Material: Stainless stell and rope

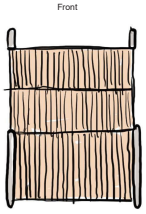
Ergonomic: Body contact with construction in the sides

Flexibility: Bouncing and floating on rope





Side



Front

Scale 1:10

6 Circular desingn criteria:

1. Low weight: Semi

2. Few componements: Yes

3. Right choise of materials: Good

4. Long life span: Yes

5. Design for disassembly: No, not realy long assimply time

6. **Small in packaging size:** No

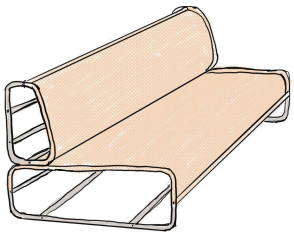
CONCEPT INFO:

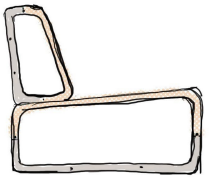
Furniture type: Lounge sofa

Material: Stainless stell and fabric

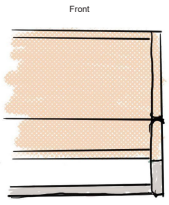
Ergonomic: Body contact with construction in the sides

Flexibility: Bouncing and floating on fabric





Side



Front

Scale 1:10

6 Circular desingn criteria:

1. Low weight: Yes

2. Few componements: Some

3. Right choise of materials: Good

4. Long life span: Looks not super durable

5. Design for disassembly: Yes

6. **Small in packaging size:** Yes

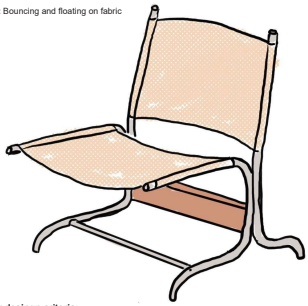
CONCEPT INFO:

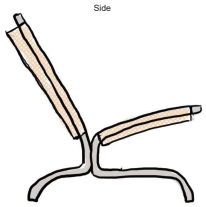
Furniture type: Lounge chair

Material: Stainless stell and fabric

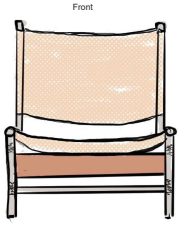
Ergonomic: Body contact with construction in the sides

Flexibility: Bouncing and floating on fabric





Side



Front

Scale 1:10

6 Circular desingn criteria:

1. Low weight: Yes

2. Few componements: Yes

3. Right choise of materials: Good

4. Long life span: Looks okay durable

5. Design for disassembly: Yes

6. **Small in packaging size:** Semi

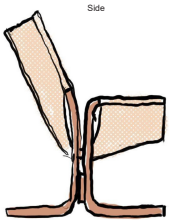
CONCEPT INFO:

Furniture type: Lounge chair

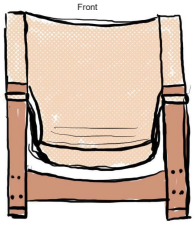
Material: Wood and fabric

Ergonomic: Body contact with construction in the sides

Flexibility: Bouncing and floating on fabric



Side



Front

Scale 1:10

6 Circular desingn criteria:

1. Low weight: Yes

2. Few componements: Yes

3. Right choise of materials: Good

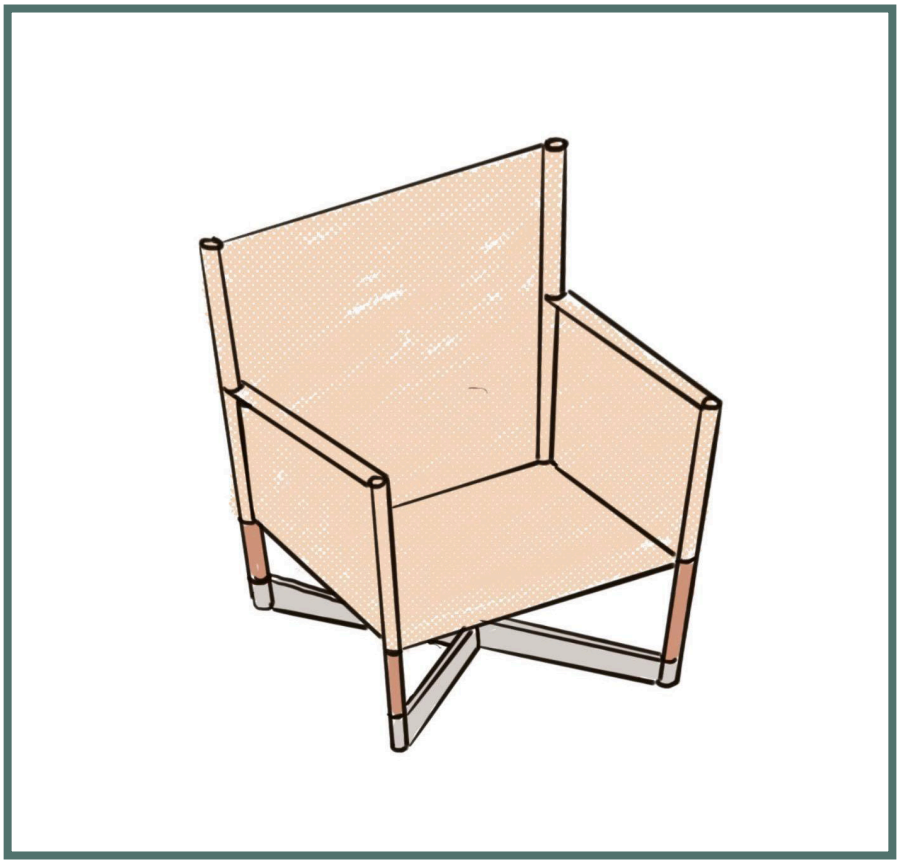
4. Long life span: Looks okay durable

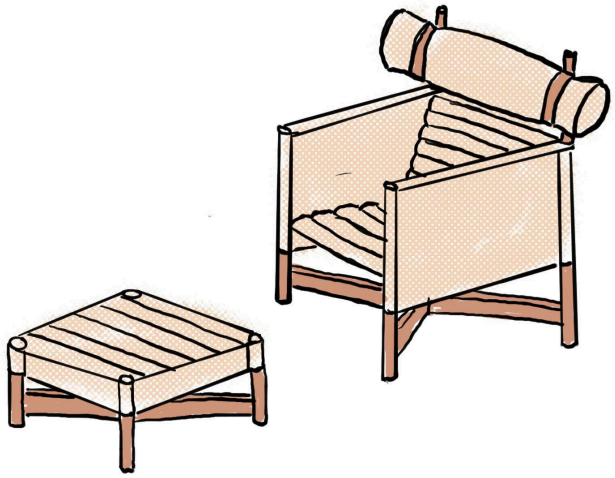
5. Design for disassembly: Yes

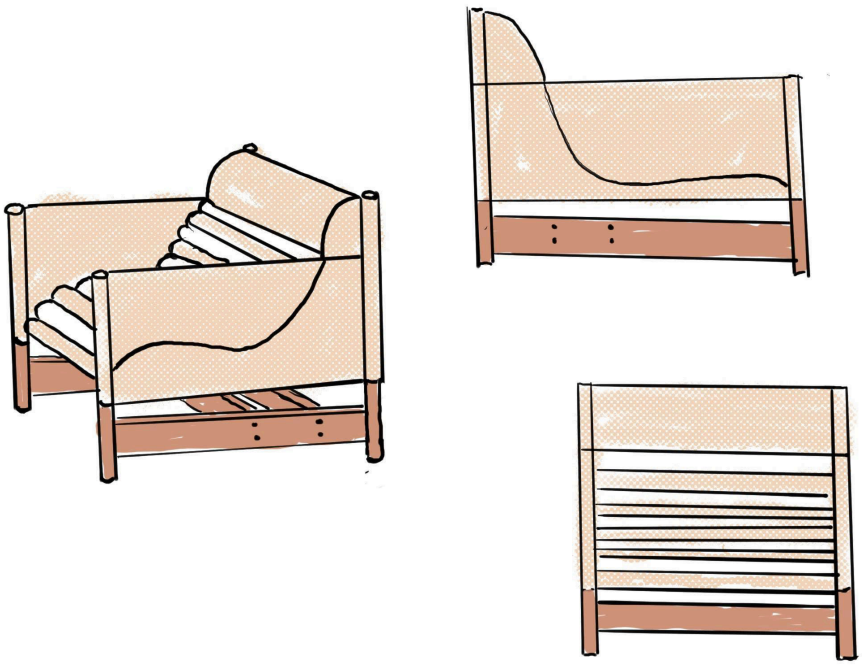
6. **Small in packaging size:** Semi

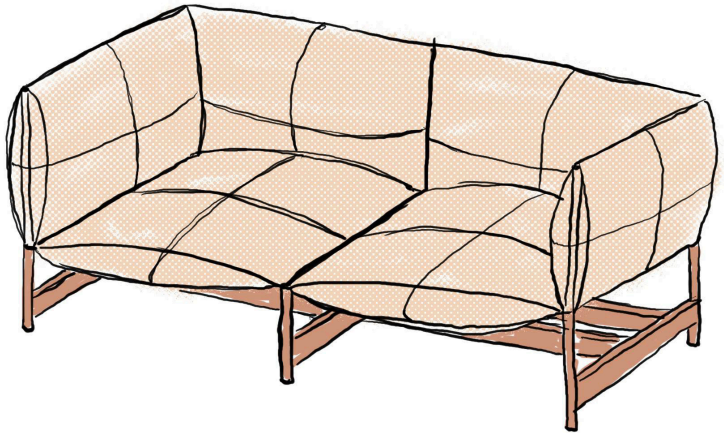
VARIATIONS

Here you see “VARIATIONS“ of my chosen concept for “LIGHT FURNITURES“, to see different opportunities within the concept, and to better refine the best solution for the concept.







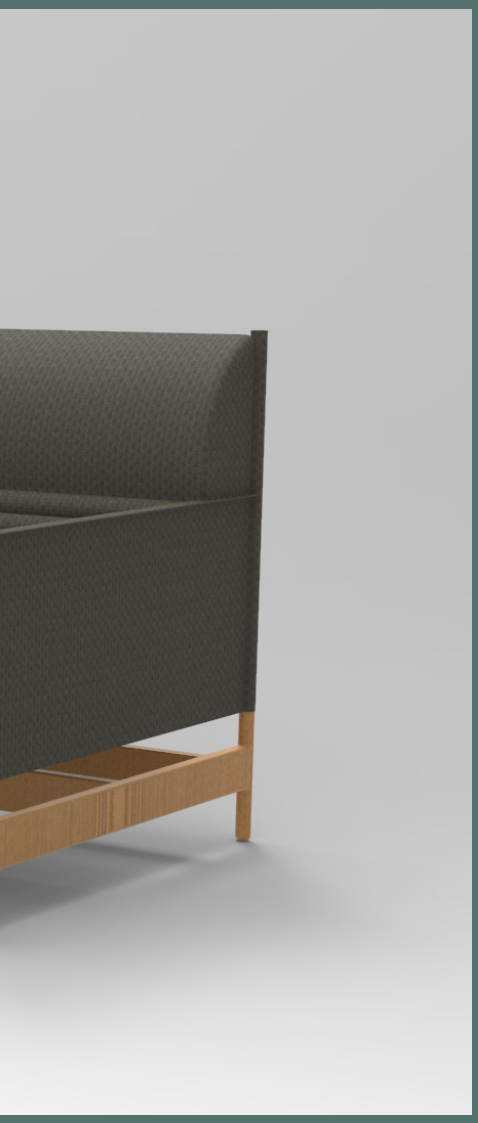


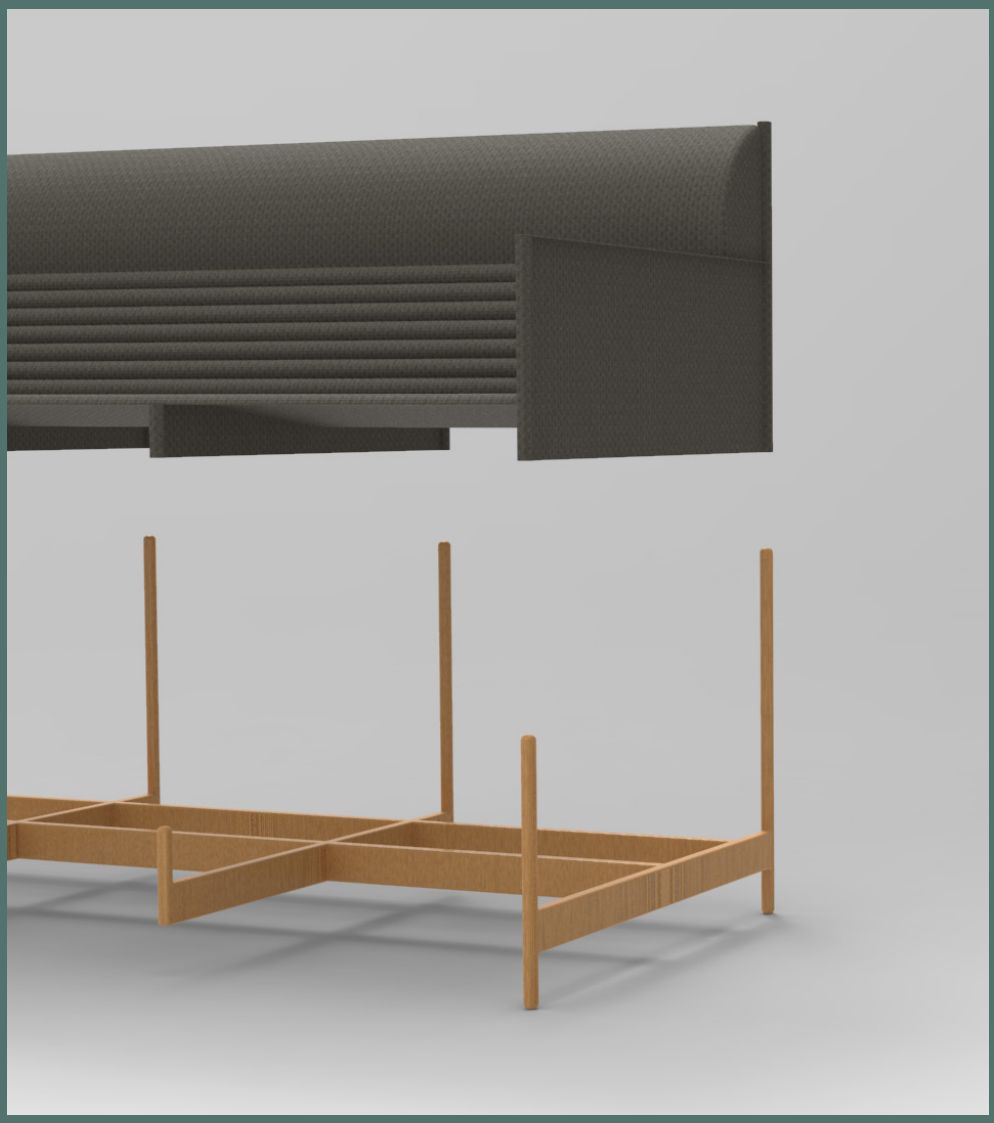
ETHIC - A SOFA FOR THE WEBSHOP

Hello! Meet ETHIC the sustainable sofa for the online furniture company, only selling their furnitures through a webshop and shipping their product all around the globe. ETHIC can be completely flat-packed, and it is designed to take up as little space as possible during transportation.

With its simple construction made of few componments, you are floating on top of a light construction, almost like a hammock .

ETHIC is made organicly of hemp textile with a small amount of hemp stuffing to give it good comfort.





HEMP:

HYBRID FURNITURE

To start my ideation phase of “HYBRID”, I made a moodboard, with furniture that can be defined as “HYBRID”: a sofa that is a hybríd of less stuffing and a flexible construction that gives it comfort.

FLOATING

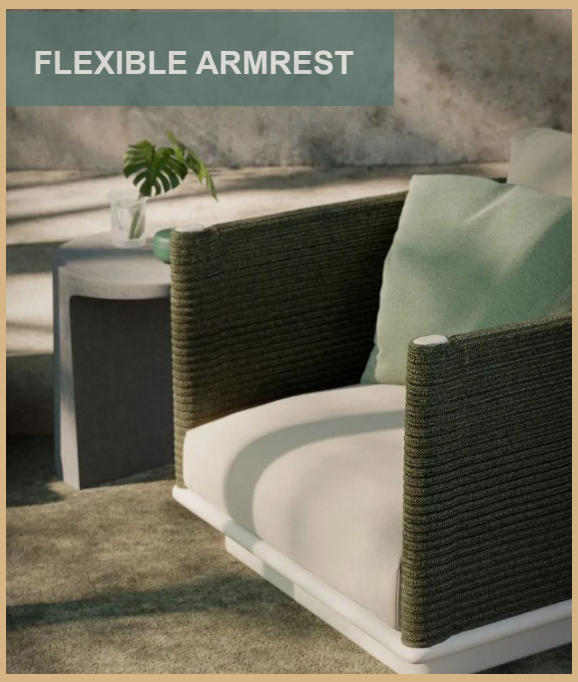
CALMING MATERIALS

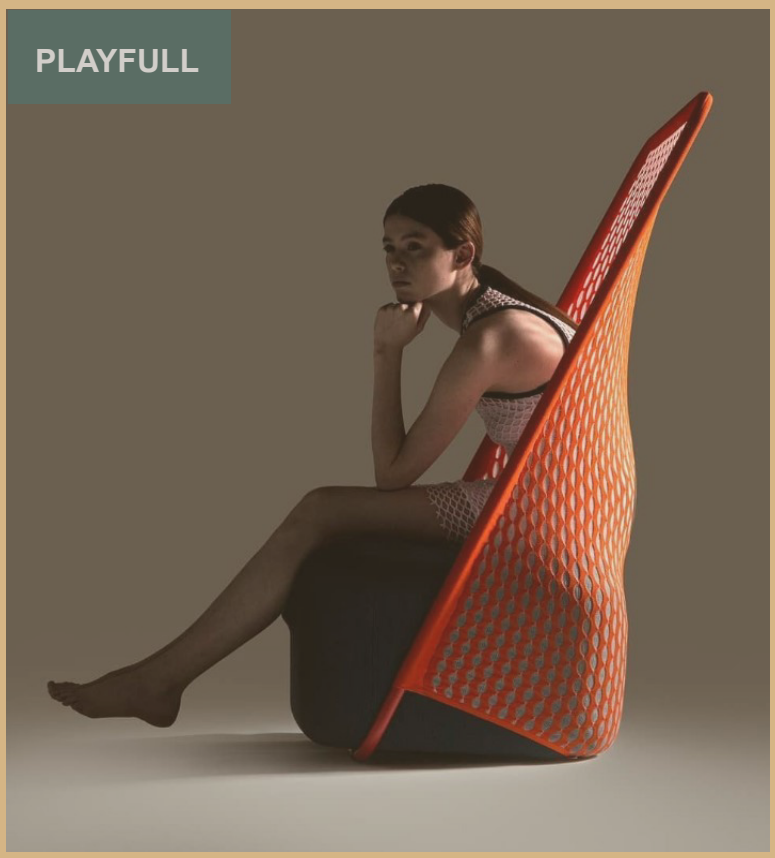
TEXTILE CREATES VOLUME

SOLID

EASY TO FLATTEN

Collage of HYBRID FURNITURE





IDEATION 1

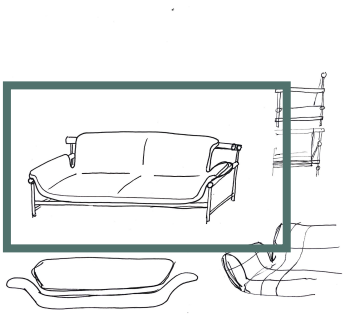
Here you see my “IDEATION 1” of “HYBRID FURNITURES“. I’m looking for concepts with both a flexible construction that gives good comfort, but also that have cushions with less stuffing material. I’m also looking for concepts that meet my 3 sustainable design criteria:

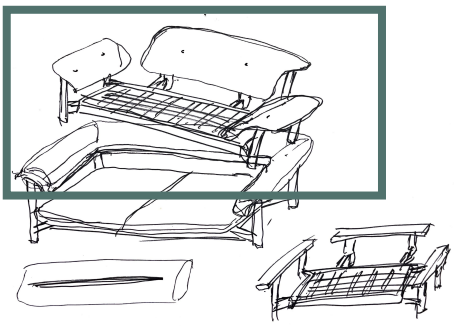
1: LOW WEIGHT: fewer resources from production and transportation.

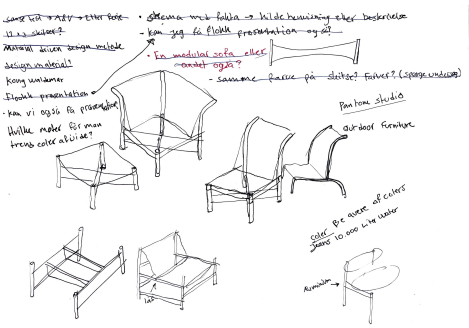
2. FEW COMPONENTS: makes manufacture easier, more delightfull to assemble by the user.

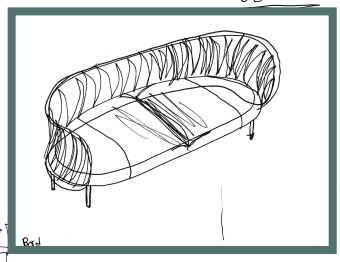
3. DISASSEMBLY: products that can be flat-packed, repaired, reused and recycled.

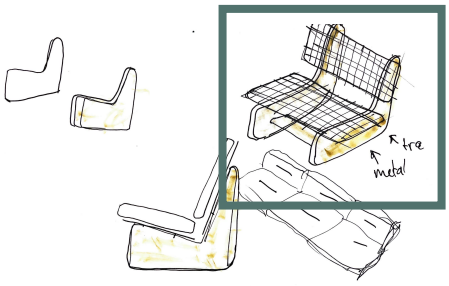
(The 9 sketches marked with green are the ones I selected to work further on in “IDEATION 2”)

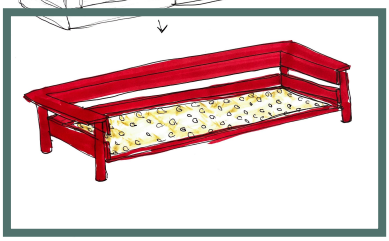


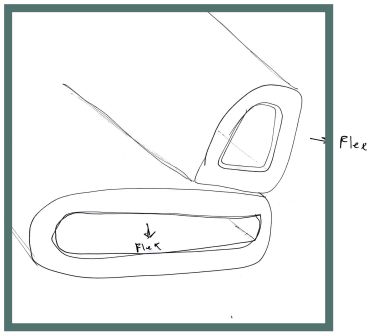


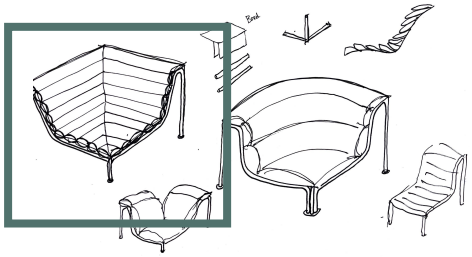

Pantom studio
outdoor furniture

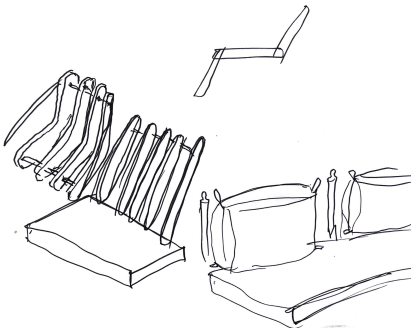

3d stick

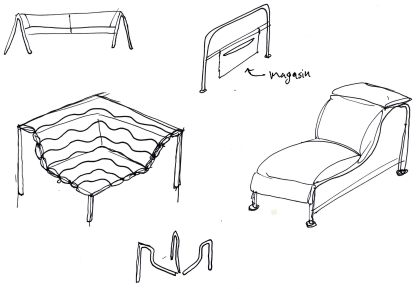

trä
metal

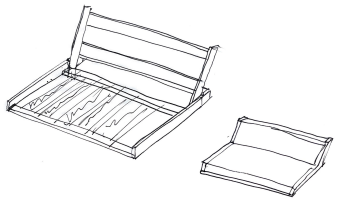


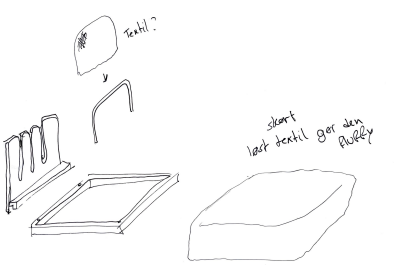

Flex

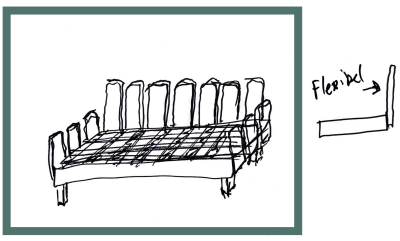


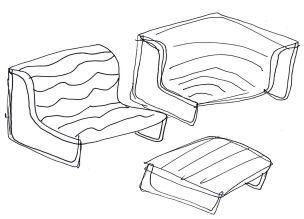







Textil?
skort
last textil ger den
puffy


Flexibel



IDEATION 2

Here you see my “IDEATION 2” of “HYBRID FURNITURES“ where I took the 9 chosen sketches from “IDEATION 1“ and made them into more defined, vectorized sketches, and further describe each of the 9 concepts’ qualities.

(To see the sketches in full size with descriptions of their qualities I refer to appendix E)

To choose a concept, I made an assessment form, where I evaluated the 9 concepts against my 3 design criteria: “LOW WEIGHT”, “FEW COMPONENTS”, and “DISASSEMBLY”.

(The concept marked with green got the highest rating in the assessment form, to see the assessment form, I refer you to Appendix E)

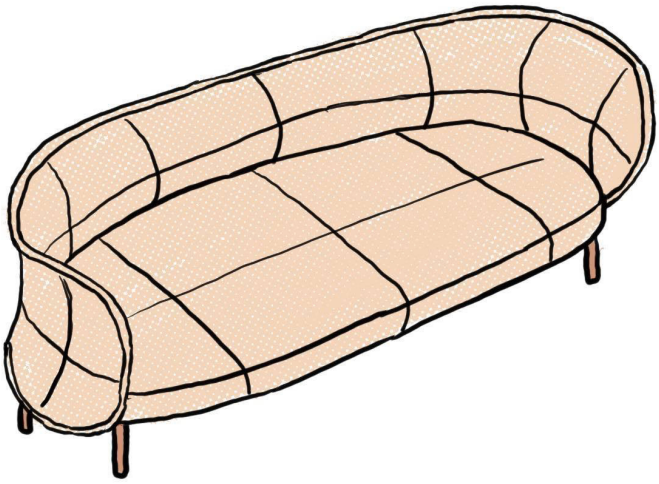
CONCEPT INFO:

Funiture type: Loung sofa

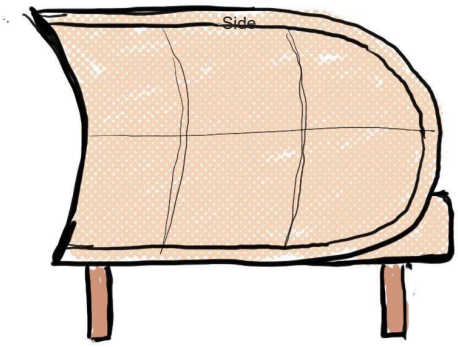
Material: Metal, wood, plantfiber, and 3D knitted fabric

Ergonomic: Good ergonomic with 3D knitted suporting you back

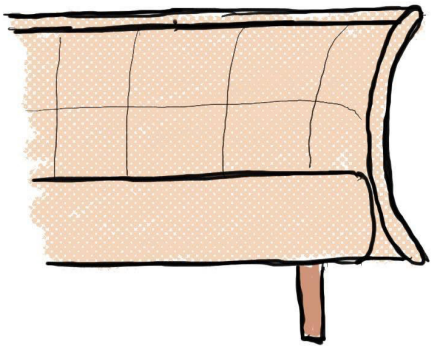
Flexibility: 3D knitted back and metal spring in seat



Side



Front



6 Circular desingn criteria:

1. Low weight: Yes

2. Few componements: Yes

3. Right choise of materials: Good

4. Long life span: Yes

5. Design for disassembly: Semi

6. **Small in packaging size:** No

Scale 1:10

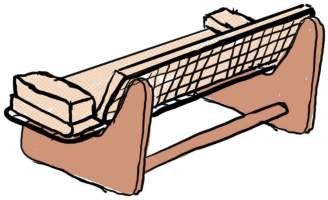
CONCEPT INFO:

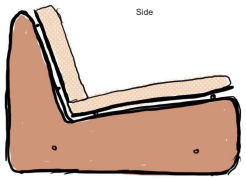
Furniture type: Lounge sofa

Material: Wood, matal, plant fiber and fabric

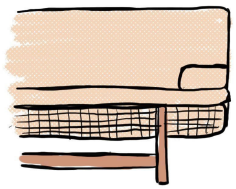
Ergonomic: Kind of hard

Flexibility: No, only the softness from plant fiber





Side



Front

Scale 1:10

6 Circular desingn criteria:

1. Low weight: No

2. Few componements: Yes

3. Right choise of materials: Good

4. Long life span: Yes

5. Design for disassembly: Yes

6. **Small in packaging size:** Semi

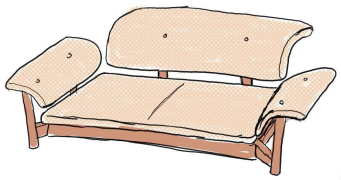
CONCEPT INFO:

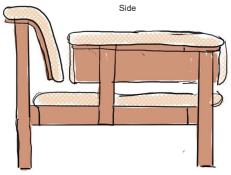
Furniture type: Lounge sofa

Material: Wood, plantfiber, and, fabric

Ergonomic: Good, no contact with construction, maby bad to sit in the corners

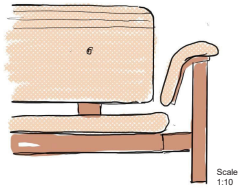
Flexibility: Allright, maby not super soft





Side

Front



Scale 1:10

6 Circular desingn criteria:

1. Low weight: Semi

2. Few componements: Semi

3. Right choise of materials: Good

4. Long life span: Yes

5. Design for disassembly: Yes

6. **Small in packaging size:** Semi

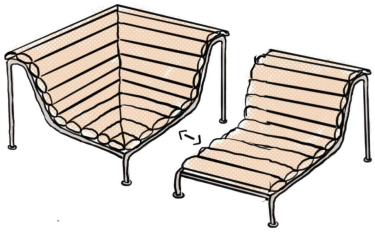
CONCEPT INFO:

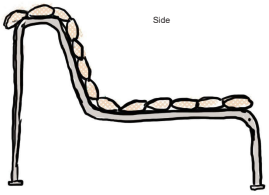
Furniture type: Lounge sofa

Material: Aluminium, 3D knitted fabric, regular fabric, and plant fiber

Ergonomic: Good the fiber protect the body from contact with the construction

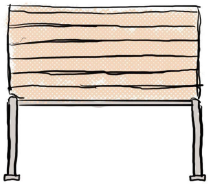
Flexibility: Bouncing and floating og 3D knitted fabric





Side

Front



Scale 1:10

6 Circular desingn criteria:

1. Low weight: Yes

2. Few componements: Yes

3. Right choise of materials: Good

4. Long life span: Yes

5. Design for disassembly: Yes

6. **Small in packaging size:** Yes

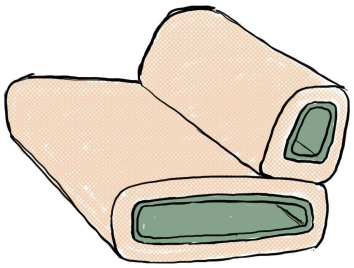
CONCEPT INFO:

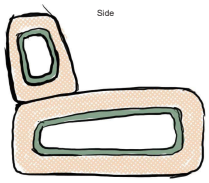
Furniture type: Lounge sofa

Material: Recycled soft plastic, plant fiber, and fabric

Ergonomic: The idear is that the recycled soft plastic bounch with the body and give good comfort

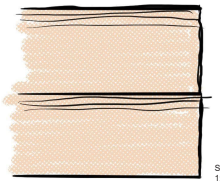
Flexibility: Good bouncing on recycled soft plastic





Side

Front



Scale 1:10

6 Circular desingn criteria:

1. Low weight: Yes

2. Few componements: Yes

3. Right choise of materials: Good

4. Long life span: I think, but not sure

5. Design for disassembly: Semi

6. **Small in packaging size:** Semi

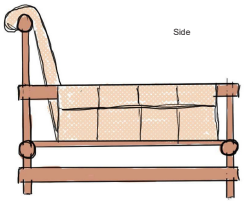
CONCEPT INFO:

Furniture type: Lounge sofa

Material: Wood, plant fiber, and fabric

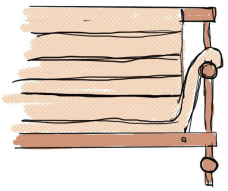
Ergonomic: Alright, not so much fiber makes it not so soft.

Flexibility: Bouncing and floating on plantfiber and fiber



Side

Front



Scale 1:10

6 Circular desingn criteria:

1. Low weight: Yes

2. Few componements: Semi

3. Right choise of materials: Good

4. Long life span: Yes

5. Design for disassembly: Yes

6. **Small in packaging size:** Yes

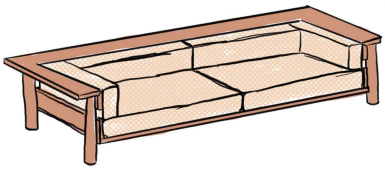
CONCEPT INFO:

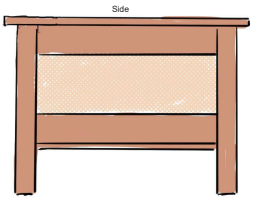
Funiture type: Lounge sofa

Material: Wood, plantfiber, and fabric

Ergonomic: A regular sofa, withe good komfort all around you

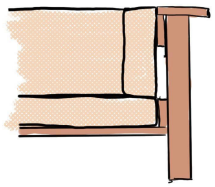
Flexibility: wooden lameller in the seat





Side

Front



Scale 1:10

6 Circular desingn criteria:

1. Low weight: No

2. Few componements: Semi

3. Right choise of materials: Good

4. Long life span: Yes

5. Design for disassembly: Semi

6. **Small in packaging size:** No

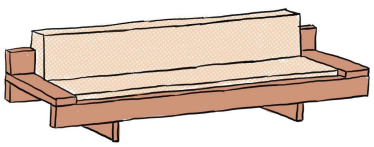
CONCEPT INFO:

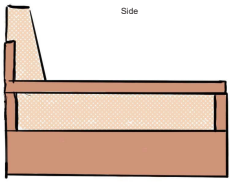
Furniture type: Lounge sofa / daybed

Material: Wood, plantfiber and fabric

Ergonomic: Allright, not soft armrest

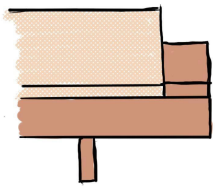
Flexibility: Bouncing on lamller ind the seat





Side

Front



Scale 1:10

6 Circular desingn criteria:

1. Low weight: Semi

2. Few componements: Yes

3. Right choise of materials: Good

4. Long life span: Yes

5. Design for disassembly: Yes

6. **Small in packaging size:** Semi

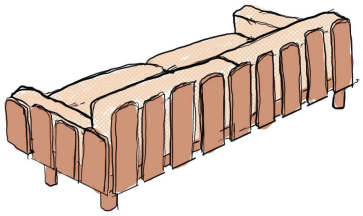
CONCEPT INFO:

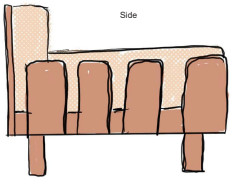
Furniture type: Lounge sofa

Material: Wood, plant fiber, and fabric

Ergonomic: Good no contact with construction

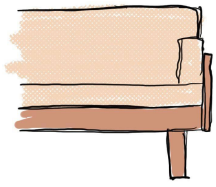
Flexibility: Sould be very good, the wood around the sofa is flexible and shapes after the body





Side

Front



Scale 1:10

6 Circular desingn criteria:

1. Low weight: No

2. Few componements: No

3. Right choise of materials: Good

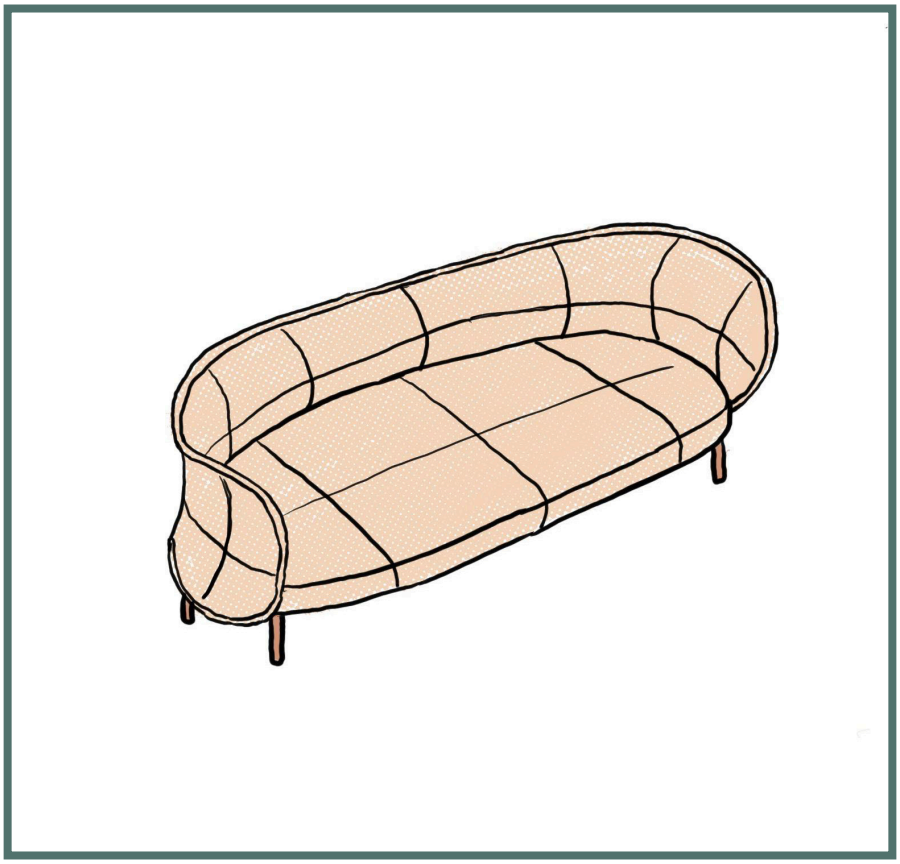
4. Long life span: Yes

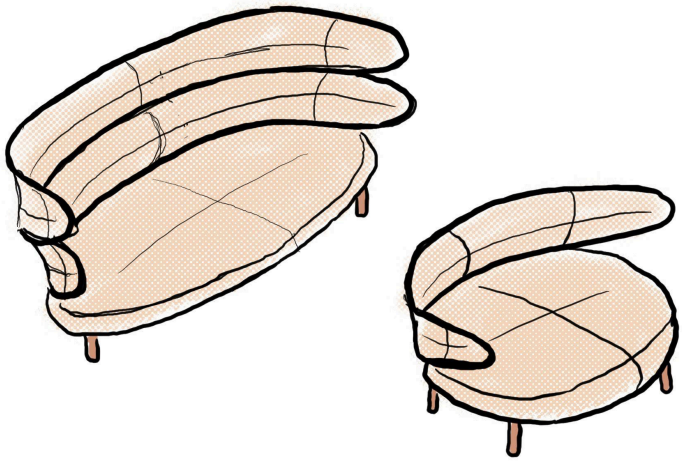
5. Design for disassembly: Yes

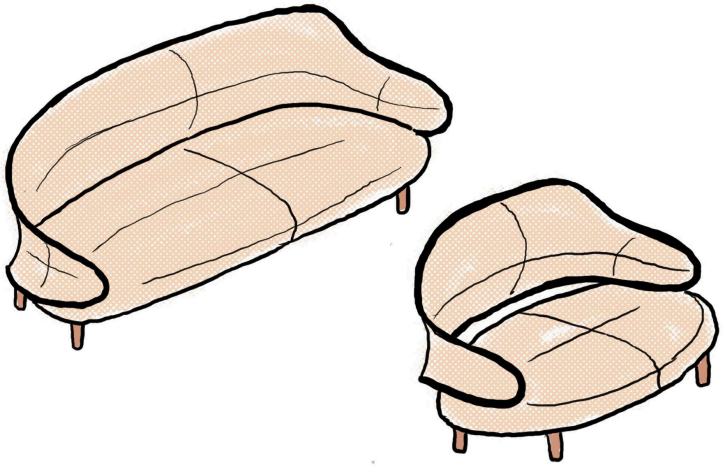
6. **Small in packaging size:** Semi

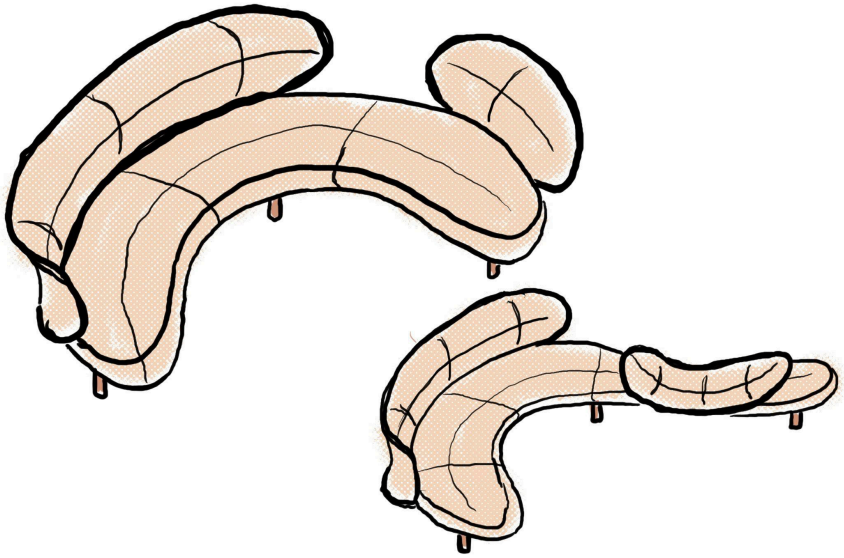
VARIATIONS

Here you see “VARIATIONS“ of my chosen concept for “HYBRID FURNITURES“, to see different opportunities within the concept, and to better refine the best solution for the concept.









REDUC - A SOFA FOR THE PUBLIC

Hello! Meet REDUC the sustainable sofa for public spaces like work, hotels, and restaurants. It is a sofa, that has a firmer comfort, not so soft that you fall asleep at work. REDUC only has half the amount of stuffing that a regular sofa uses, because of its innovative 3D knitted flexible back.

REDUC has an all recyclable construction, made of few components, which makes it easy to repair through its life time.

REDUC has all biodegradeble cushions made of hemp textile, with talalay, a natural latex foam, and buckwheat as stuffing.

TALALAY: 

BUCKWHEAT: 

VOLUMINOUS FURNITURE

To start my ideation phase of “VOLUMINOUS”, I made a moodboard, with furniture that can be defined as “VOLUMINOUS”: a sofa that has a big amount of stuffing and looks voluminous.

MODULAR

FUNCTIONAL STITCHING

CONNECTING SYSTEM

AESTHETIC STITCHING

ARMREST STITCHING

Collage of VOLUMINOUS FURNITURE

IDEATION 1

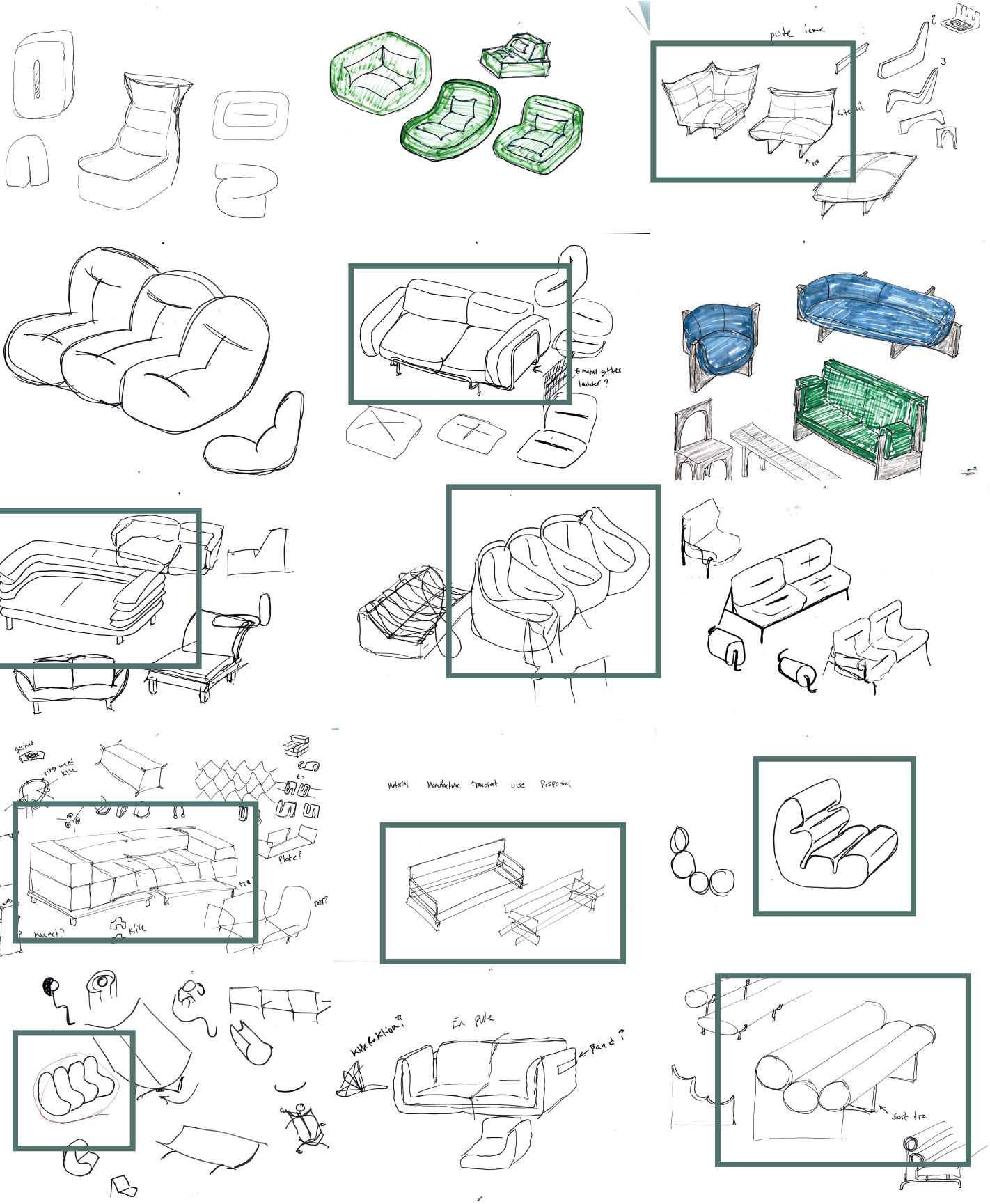
Here you see my “IDEATION 1” of “VOLUMINOUS FURNITURE”. I’m looking for concepts with both a flexible construction that gives good comfort, but also cushions with less stuffing material. I’m also looking for concepts that meet my 3 sustainable design criteria:

1: LOW WEIGHT: fewer resources from production and transportation.

2. FEW COMPONENTS: makes manufacture easier, more delightfull to assemble by the user.

3. DISASSEMBLY: products that can be flat-packed, repaired, reused and recycled.

(The 9 sketches marked with green are the ones I selected to work further on in “IDEATION 2”)


Material Manufacture transport use Disposal

IDEATION 2

Here you see my “IDEATION 2” of “VOLUMINOUS FURNITURE“ were I took the 9 choen sketches from “IDEATION 1“ and made them into more defined vectorized sketches, and describe each of the 9 concepts’ qualities.

(To see the sketches in full size with descriptions of their qualities I refer to appendix E)

To choose a concept, I made an assessment form, where I evaluated the 9 concepts against my 3 design criteria: “LOW WEIGHT”, “FEW COMPONENTS”, and “DISASSEMBLY”.

(The concept marked with green got the highest rating in the assessment form, to see the assessment form, I refer you to Appendix E)

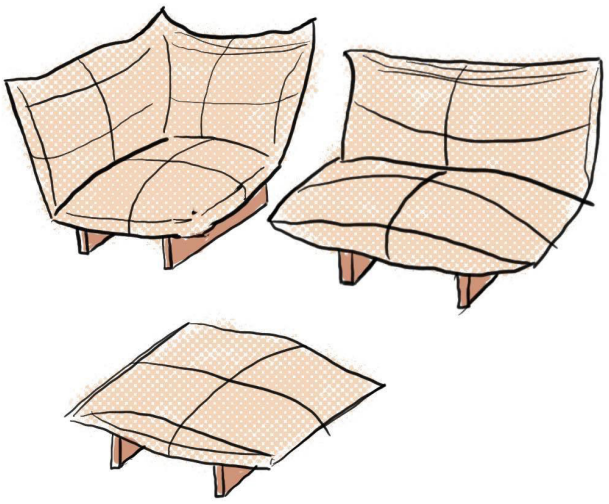
CONCEPT INFO:

Furniture type: Modular lounge sofa

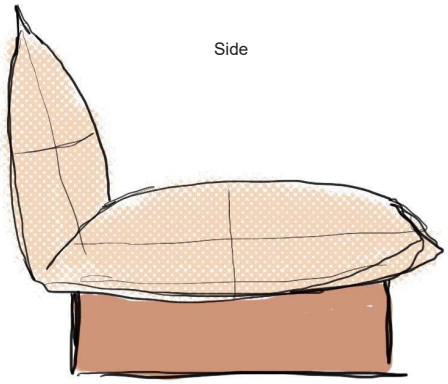
Material: Wood, plant fiber, and fabric

Ergonomic: Good no contact with construction

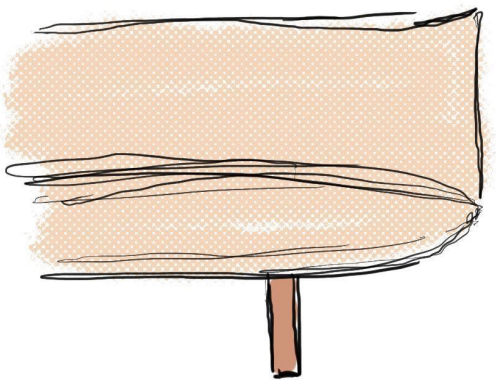
Flexibility: Sould be very good, the wood around the sofa is flexible and shapes after the body



Side



Front



Scale
1:10

6 Circular desingn criteria:

1. Low weight: Semi

2. Few componements: Semi

3. Right choise of materials: Good

4. Long life span: Yes

5. Design for disassembly: Yes

6. **Small in packaging size:** Semi

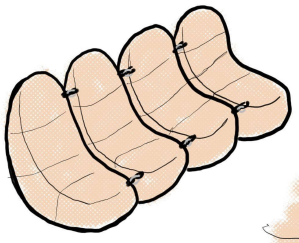
CONCEPT INFO:

Furniture type: Beanback Lounge sofa and chair

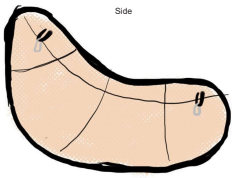
Material: Wood, plant fiber, and fabric

Ergonomic: Good no contact with construction

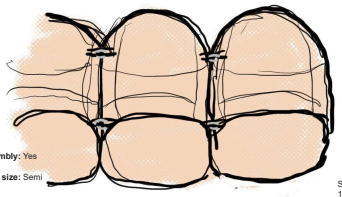
Flexibility: Sould be very good a lot of plant fiber



Side



Front



Scale 1:10

6 Circular desingn criteria:

1. Low weight: Semi

2. Few componements: Yes

3. Right choise of materials: Good

4. Long life span: Yes

5. Design for disassembly: Yes

6. **Small in packaging size:** Semi

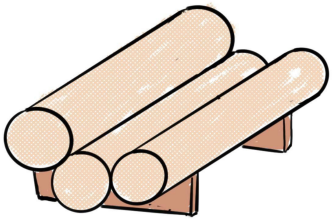
CONCEPT INFO:

Furniture type: Lounge sofa

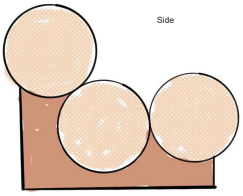
Material: Wood, plant fiber, recycled soft plastic and fabric

Ergonomic: Good no contact with construction, but no armrests

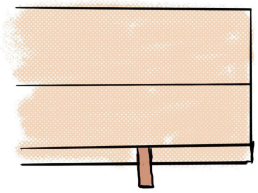
Flexibility: Sould be good because of the flexible soft recycled plastic inside and the fiber



Side



Front



Scale 1:10

6 Circular desingn criteria:

1. Low weight: Semi

2. Few componements: Semi

3. Right choise of materials: Good

4. Long life span: Yes

5. Design for disassembly: Yes

6. **Small in packaging size:** Semi

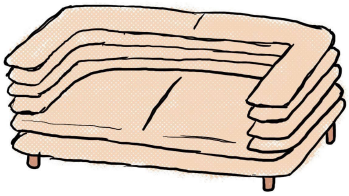
CONCEPT INFO:

Furniture type: Lounge sofa

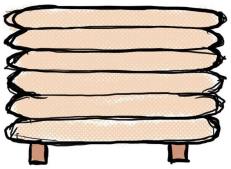
Material: Wood, plant fiber, and fabric

Ergonomic: Good no contact with construction

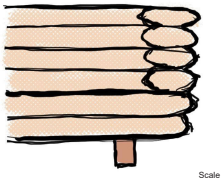
Flexibility: Good a lot of fiber



Side



Front



Scale 1:10

6 Circular desingn criteria:

1. Low weight: Semi

2. Few componements: Semi

3. Right choise of materials: Good

4. Long life span: Yes

5. Design for disassembly: Semi

6. **Small in packaging size:** Semi

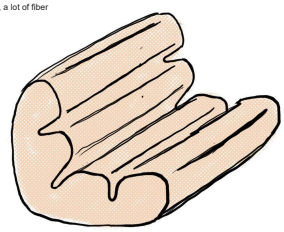
CONCEPT INFO:

Furniture type: Modular Lounge chair

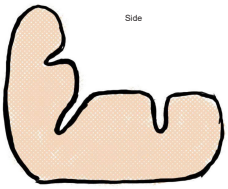
Material: Wood, plant fiber, and fabric

Ergonomic: Good

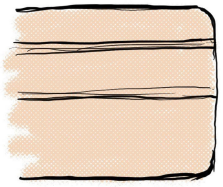
Flexibility: Good, a lot of fiber



Side



Front



Scale 1:10

6 Circular desingn criteria:

1. Low weight: Semi

2. Few componements: Yes

3. Right choise of materials: Good

4. Long life span: Yes

5. Design for disassembly: Semi

6. **Small in packaging size:** Semi

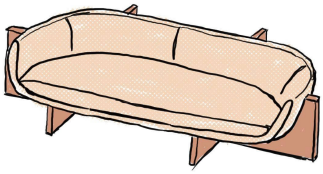
CONCEPT INFO:

Furniture type: Lounge sofa

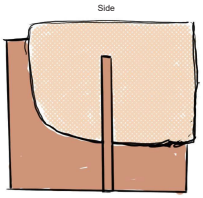
Material: Wood, plant fiber, and fabric

Ergonomic: Good a lot of stuffing

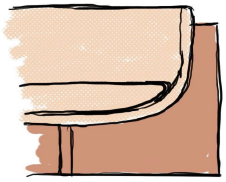
Flexibility: Good a lot of stuffing



Side



Front



Scale 1:10

6 Circular desingn criteria:

1. Low weight: No

2. Few componements: Yes

3. Right choise of materials: Good

4. Long life span: Yes

5. Design for disassembly: Semi

6. **Small in packaging size:** Semi

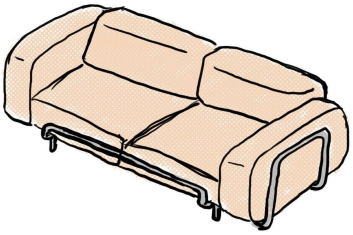
CONCEPT INFO:

Furniture type: Lounge sofa

Material: Metal, plant fiber, and fabric

Ergonomic: Good no contact with construction

Flexibility: Good, a lot of fiber in seat and back



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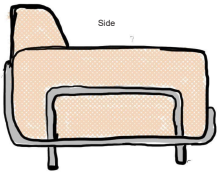
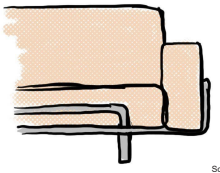


Front



Scale 1:10

6 Circular desingn criteria:

1. Low weight: Yes

2. Few componements: Yes

3. Right choise of materials: Good

4. Long life span: Yes

5. Design for disassembly: Yes

6. **Small in packaging size:** Semi

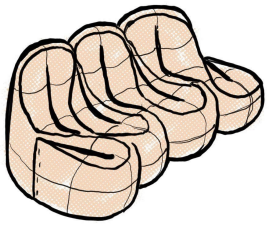
CONCEPT INFO:

Furniture type: Lounge sofa

Material: Plant fiber, and fabric

Ergonomic: Good no contact with construction

Flexibility: Good a lot of plant fiber



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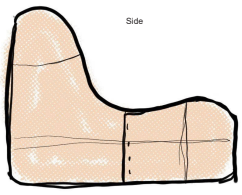

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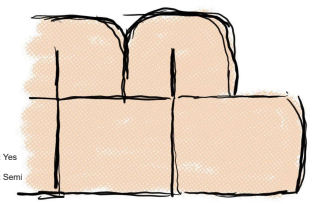


Scale 1:10

6 Circular desingn criteria:

1. Low weight: Yes

2. Few componements: Yes

3. Right choise of materials: Good

4. Long life span: Yes

5. Design for disassembly: Yes

6. **Small in packaging size:** Semi

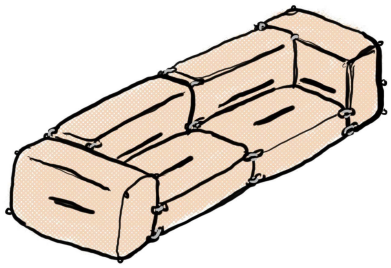
CONCEPT INFO:

Furniture type: Modular lounge sofa

Material: Plant fiber, and fabric

Ergonomic: Good no contact with construction

Flexibility: Good a lot of fiber



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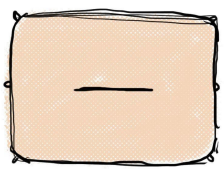

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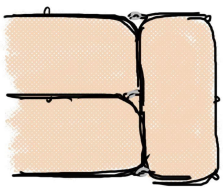


Scale 1:10

6 Circular desingn criteria:

1. Low weight: Yes

2. Few componements: Yes

3. Right choise of materials: Good

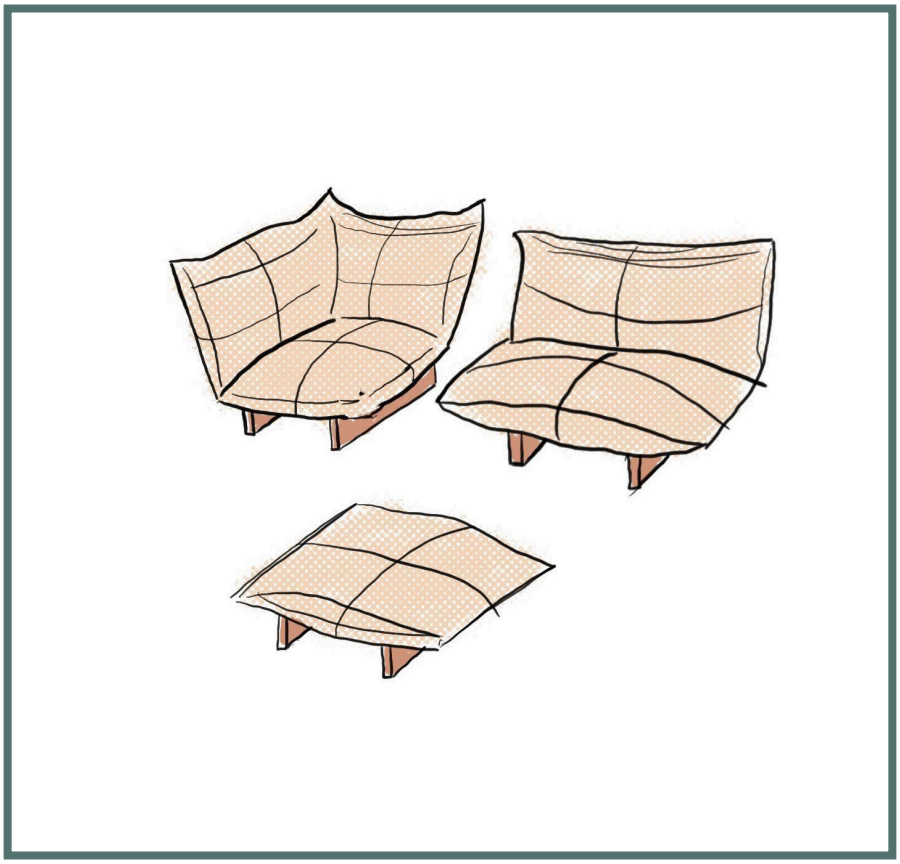
4. Long life span: Yes

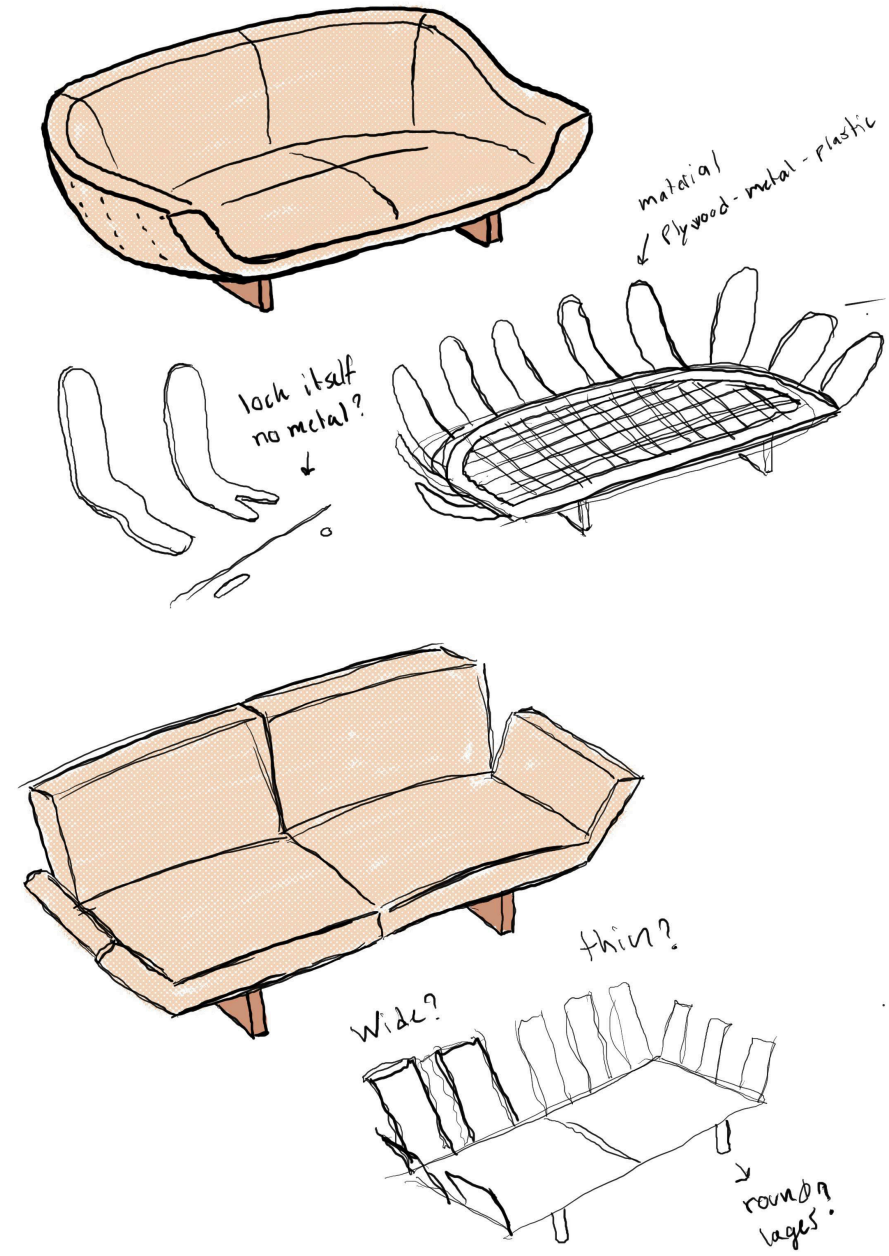
5. Design for disassembly: Yes

6. **Small in packaging size:** Yes

VARIATIONS

Here you see “VARIATIONS“ of my chosen concept for “VOLUMINOUS FURNITURE“, to see different opportunities within the concept, and to better refine the best solution for the concept.




material
Plywood - metal - plastic
lock itself
no metal?
thin?
Wide?
round?
legs?

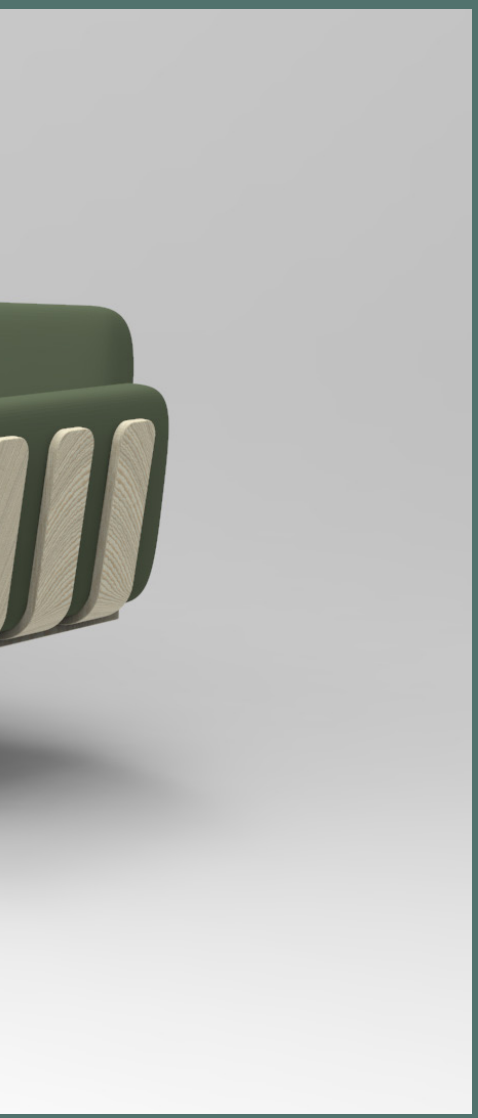
BASIC - A SOFA FOR THE HOME

Hello! Meet BASIC the sustainable sofa for the home. If you want a reliable, solid, and durable sofa that stays with you through life, this is the one!

BASIC has a very good comfort with its cushions made of hemp, and its flexible construction.

BASIC has a construction with few components, designed for disassembly, so it can be flat-packed during transportation and easily repaired through its life time.

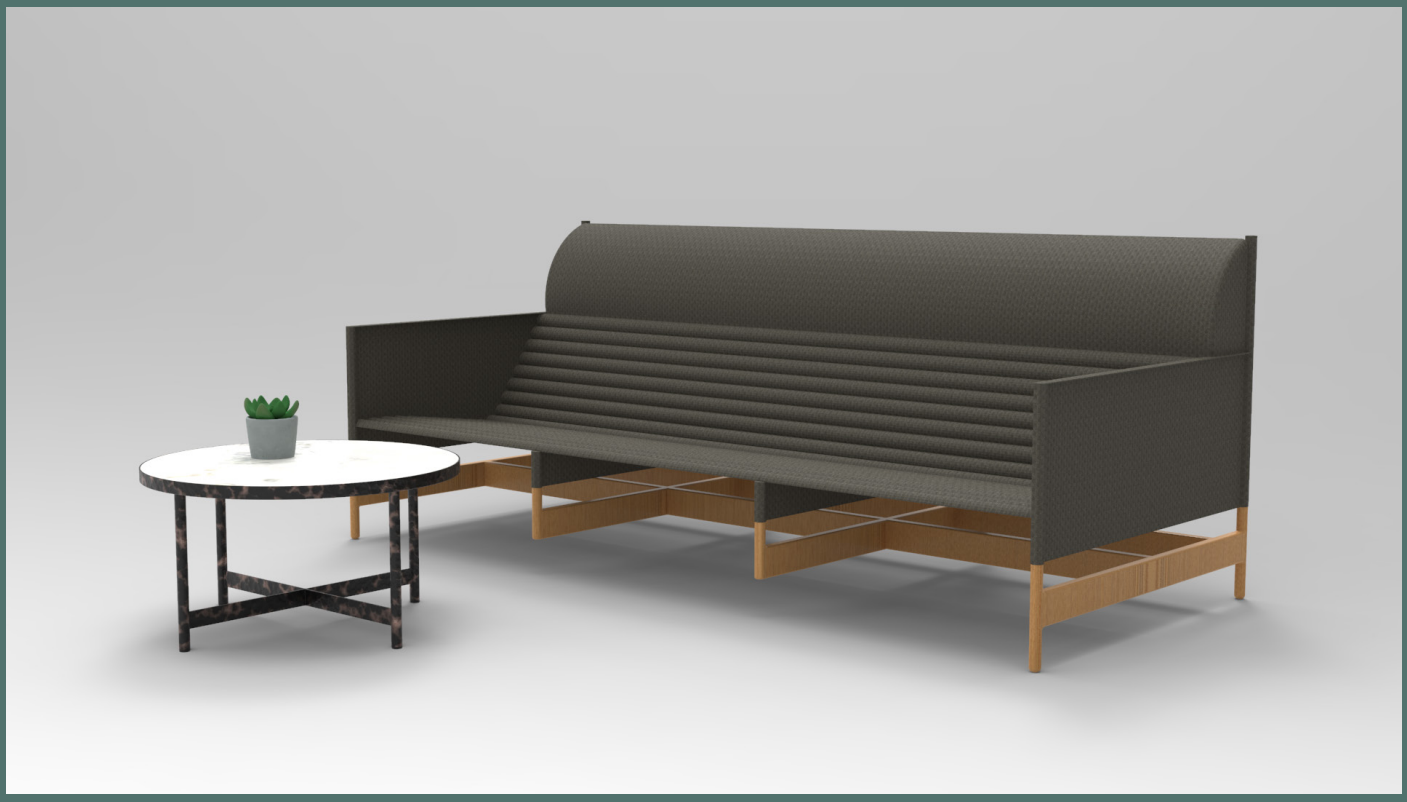
BASIC is made 100% organicly with all biodegradeble materials.



HEMP:

CHAPTER 4 CONCLUSION

1: ETHIC - A SOFA FOR THE SHIPPING



2: REDUC - A SOFA FOR THE PUBLIC

3: BASIC - A SOFA FOR THE HOME

FROM 3 TO 1 CONCEPT

All my 3 concepts are good sofas with strong ideas and high potential in all their catagories, but I have chosen to work further with: BASIC

BEST IN TEST & FEEDBACK

This project is about showing the potential of plant fibre stuffing, and hemp got the best results and acceptance.

MEETS THE 3 SUSTAINABLE CRITERIA

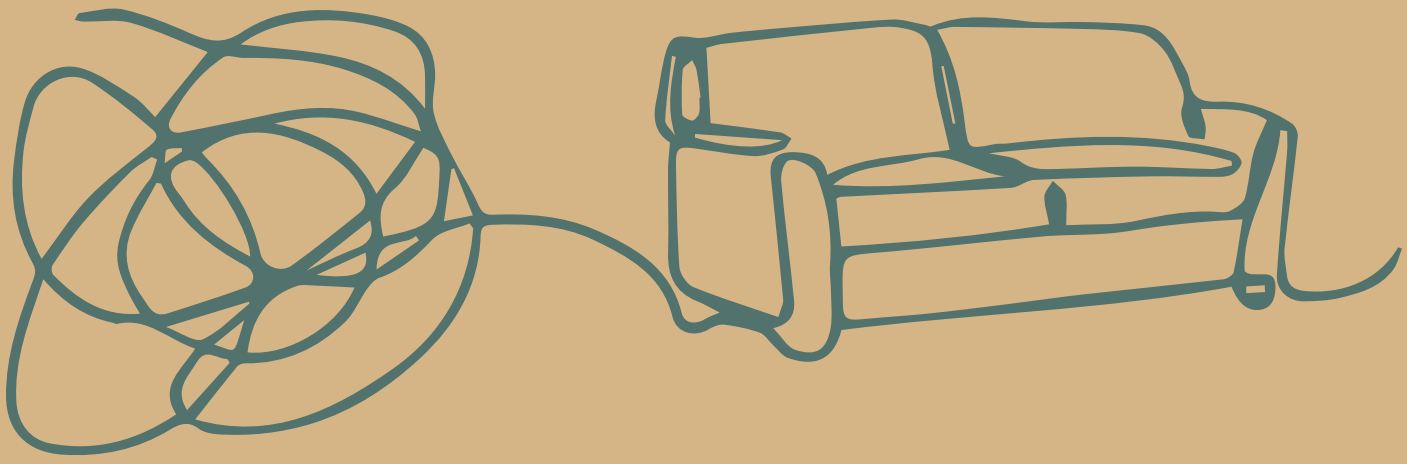
BASIC meets the sustainable criteria: “LOW WEIGHT”, “FEW COMPONENTS”, and “DISASSEMBLY”.

A SOFA FOR MY PRIMARY SEGMENT

BASIC is the perfect sofa for my primary segment: Adult couples or singles aged 35-60 years who are environmentally conscious and want to replace their old furniture with a new one that is durable and has good comfort that can follow them through life.

CHAPTER 5

PRODUCT DEVELOPMENT



MY PRODUCT DEVELOPMENT JOURNEY

In this product development you can read about how I have designed the entire sofa construction through process of ideation for each componment in the sofa. This product development is going to consist of 3 steps:

STEP 1:

Choosing the overall sofa dimensions.

STEP 2:

Ideation and selection of how the entire construction of the sofa should be. The design of the back, seat, and cushions.

STEP 3:

A conclusion where you can see the final draft for the entire sofa construction and each component.

OVERALL SOFA DIMENSIONS

The way I have selected the overall sofa dimensions for the sofa is by:

1: Reading the book SITTMÖBLERS MÅTT, written by Erik Berglund. It's a book recognized by design schools and the furniture industry as a source for furniture dimensions.

2: Talking to the furniture designer Anderssen&Voll, and they have told me what dimensions they use for there furniture.

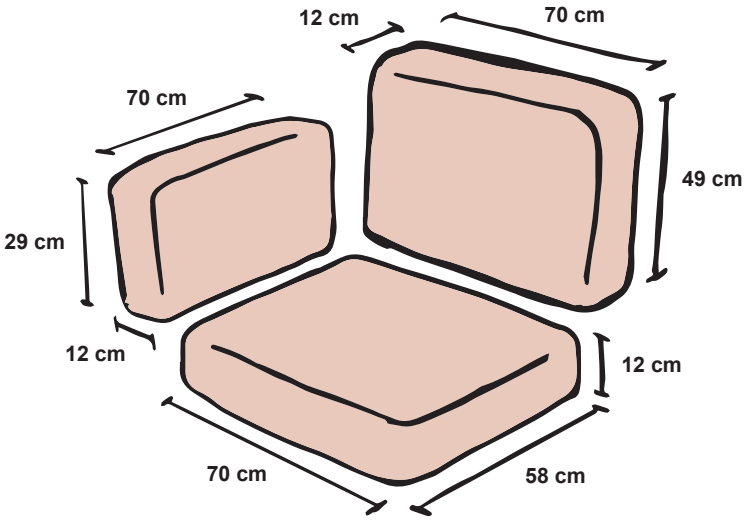
3. Measuring the dimensions of the sofas at school, in my friend's apartment, and in my own apartment.

After having assessed this information, I have tested out the dimensions and angles by moving around cushions in different hights and angles, to get the right indication of which works best for the sofa. On the next page you see my chosen dimensions.

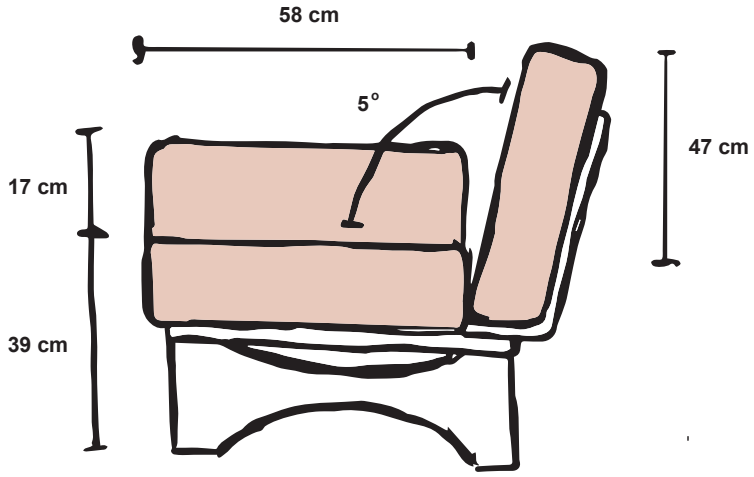
Here you see my test setup were i test dimentions and angles.

Here i messure the hight of my freind's sofa.

CUSHION DIMENSIONS



MAIN DIMENSIONS



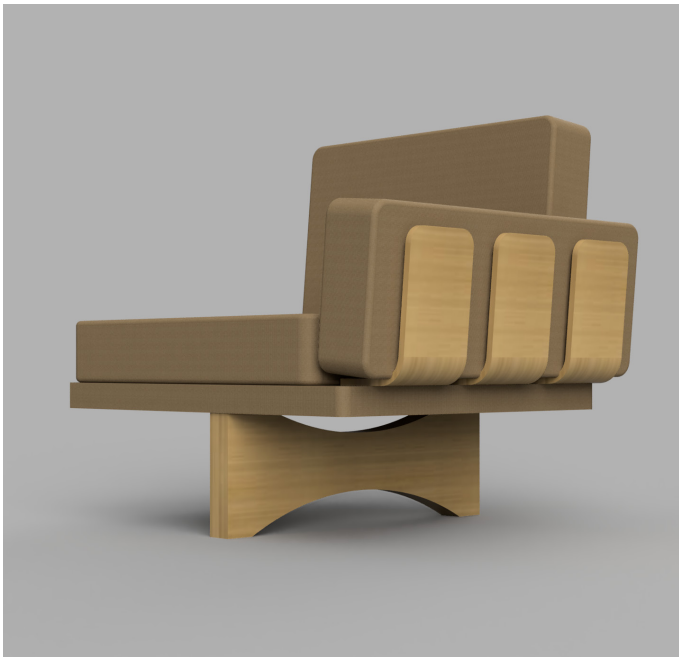
MAIN CONSTRUCTION (1 OF 3)

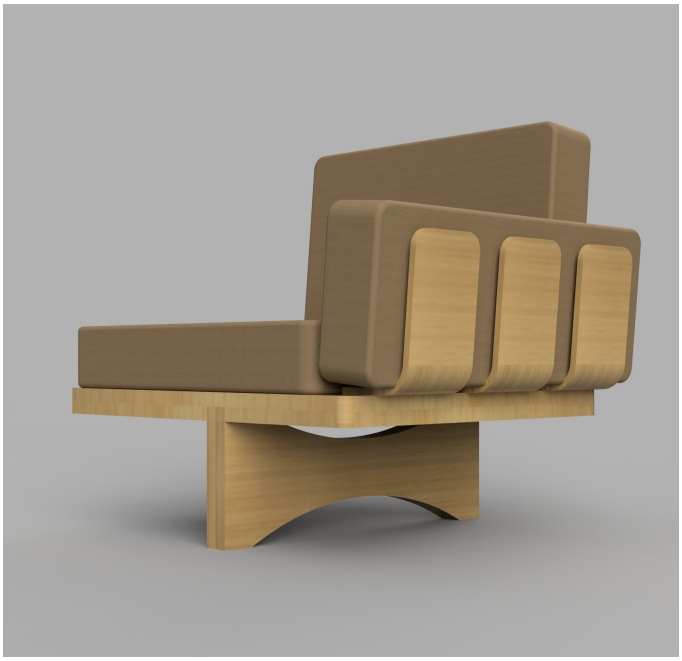
FRAME WITH OR WITHOUT VISIBLE BEAMS?

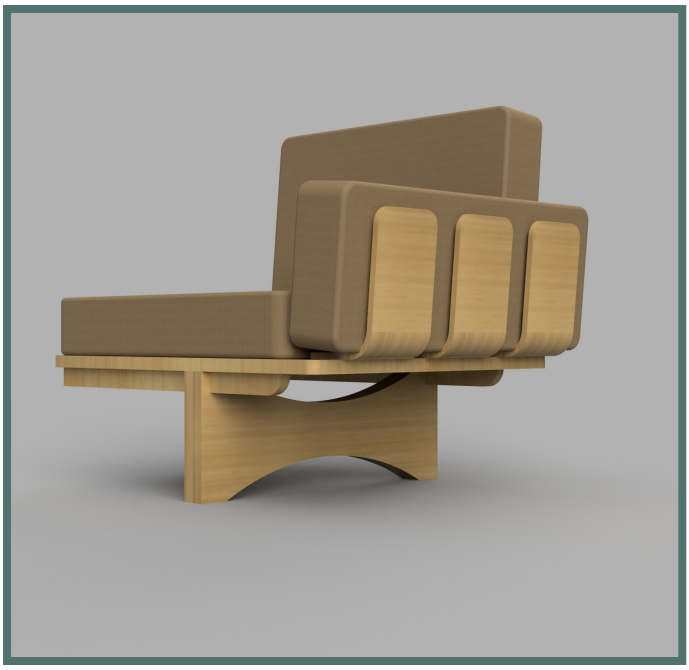
Every sofa needs a strong frame to make it durable.

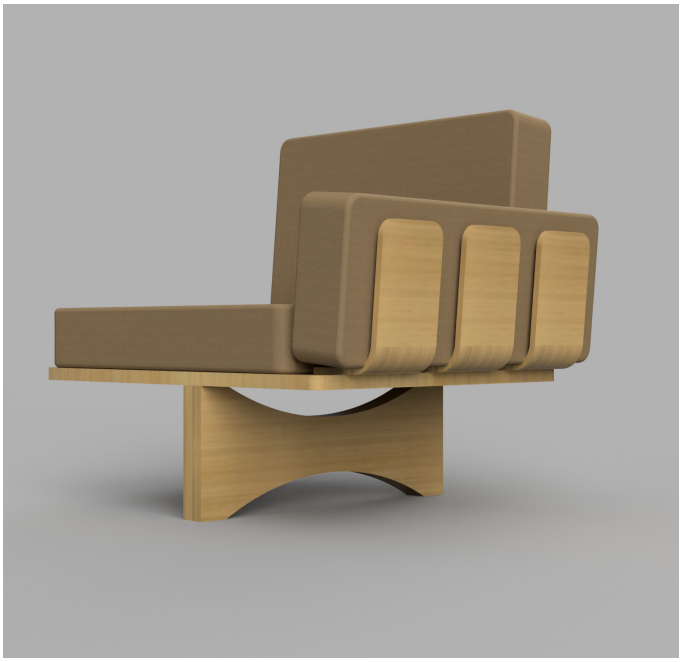
At first I wanted a frame without a beam under it, because it gives the furniture a lightness, with nothing under the frame. But after talking to the teachers in AHO's wood workshop, they told me that if its going to be constructed of wood, it needs a supporting beam under its frame, otherwise it will not be strong enough.

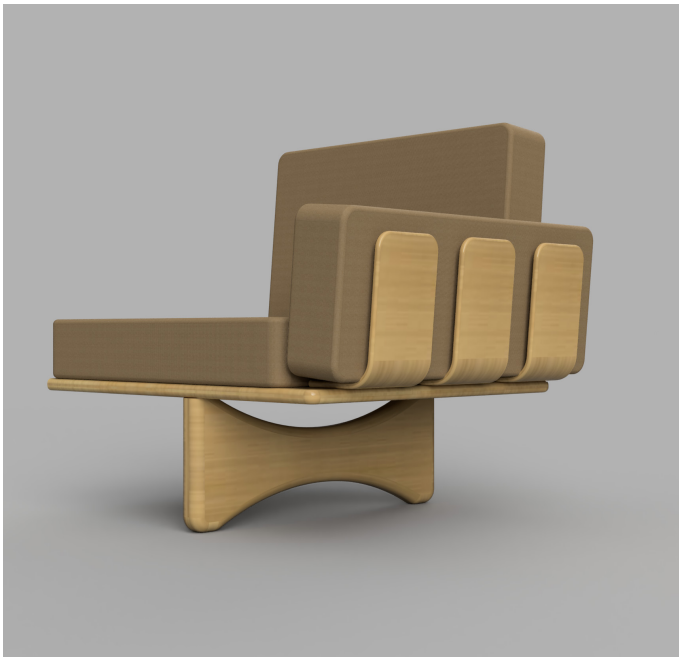
I ended up with two small beams, which are placed with some distance from the edge of the frame, so it all remains hidden from the eye when seeing the sofa from a standing perspective.

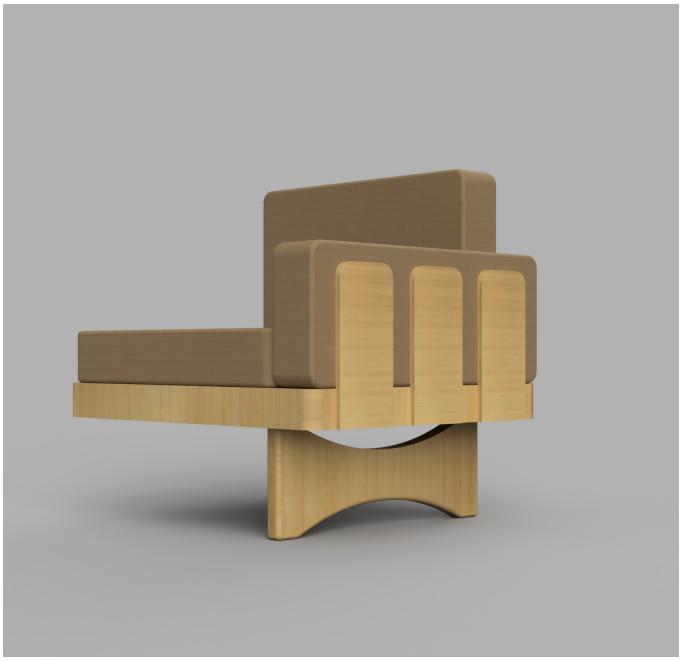








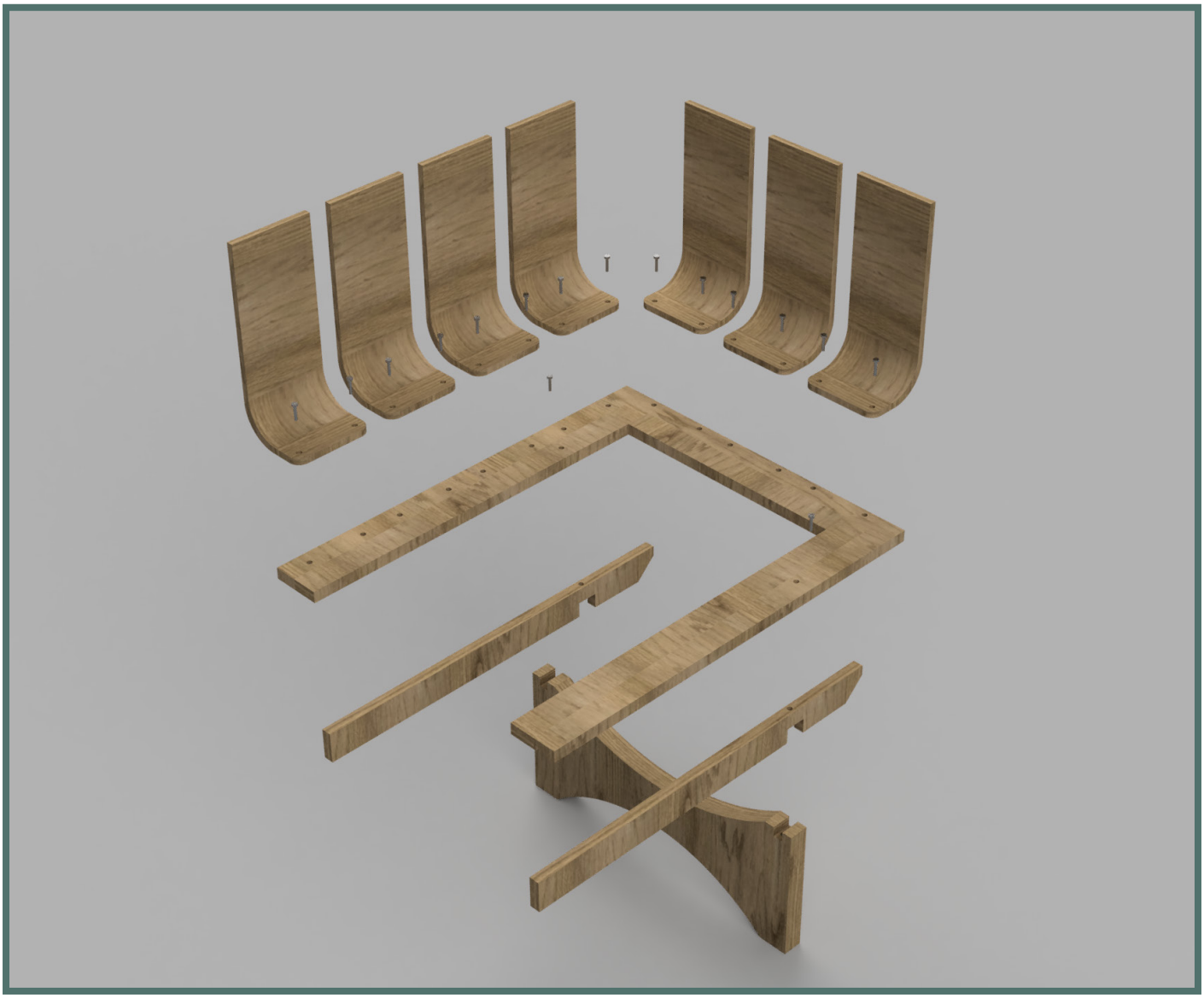


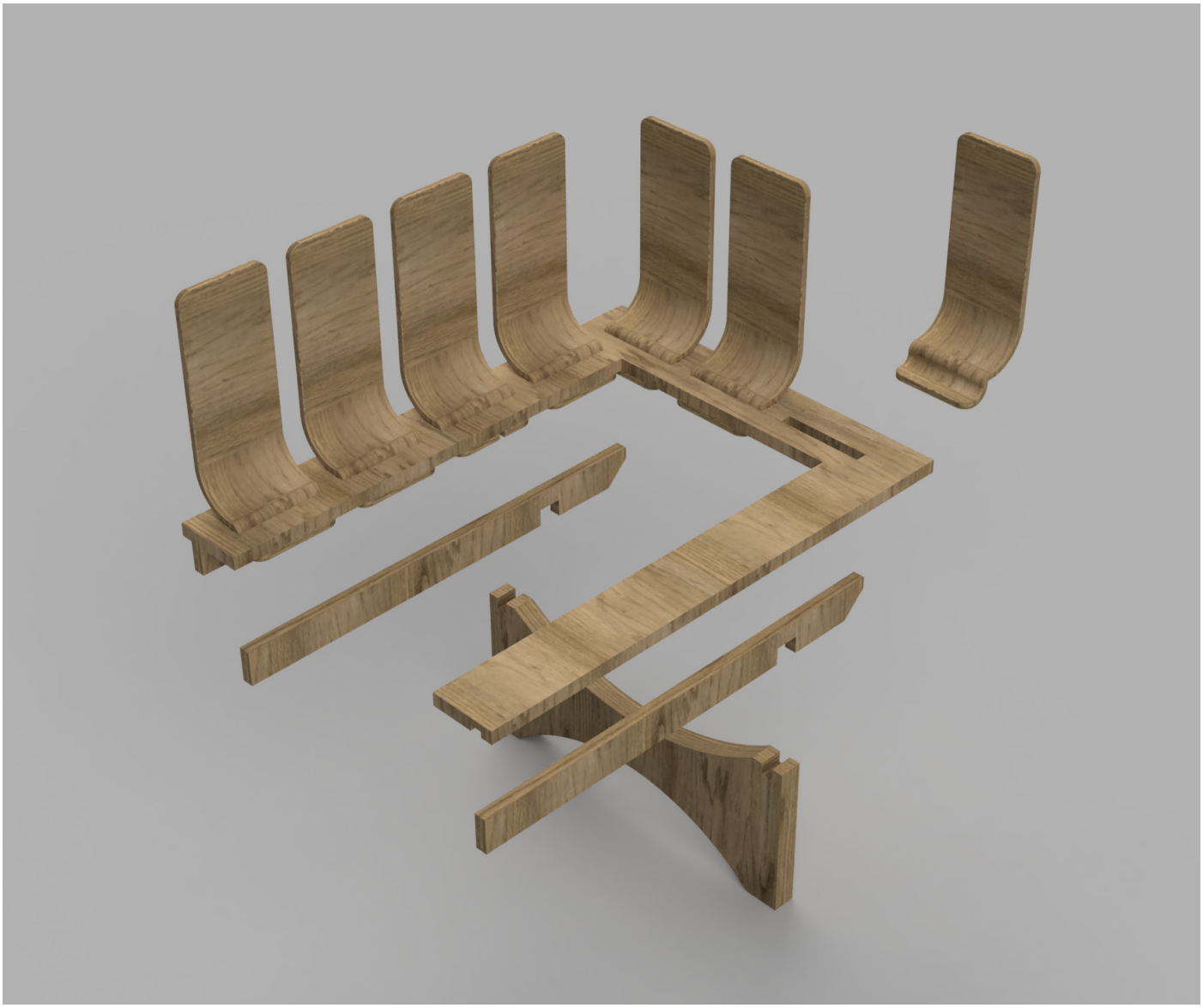


MAIN CONSTRUCTION (2 OF 3)

SCREWS OR NO SCREWS?

When it came to making the construction work, I looked into either having a construction that had no screws, were every part was fastened with joints. However, with this option, after you have assembled it, you can not move it around without it falling apart. So i ended up with using screws so you easily can move the sofa around if needed. I want screws that are biodegradable, so an option would be to make it out of biodegradable hard plastic.

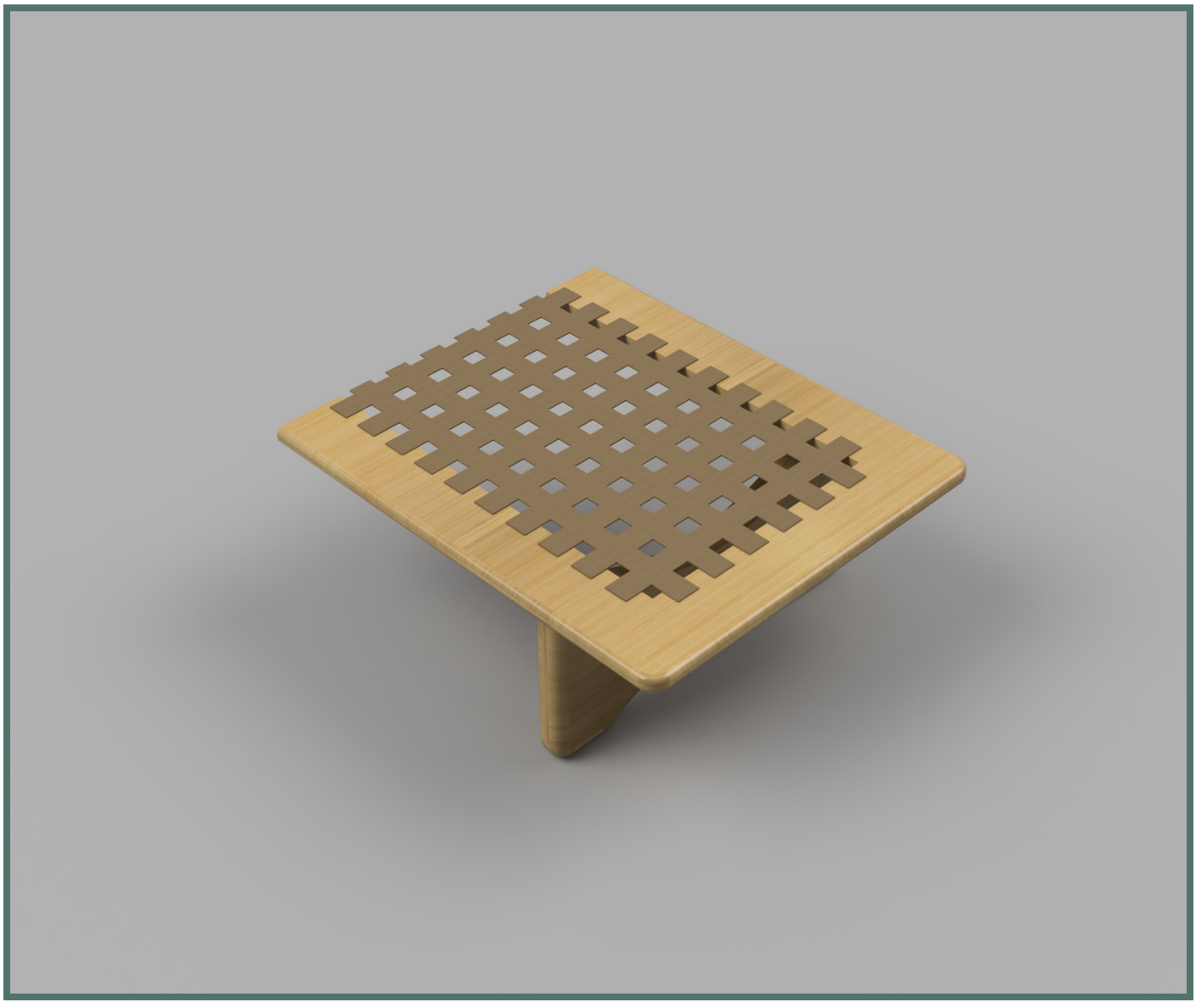




MAIN CONSTRUCTION (3 OF 3)

WOOD SLATS OR HEMP RIBBONS?

As flexiblity for the seat I looked into both slats and ribbons, but ultimately chose hemp ribbons. I decided this because Eddie King recommend it, and he had used it in his upholstery before. He told me he thinks it has better flexibilty than slats.



THE BACK & ARMREST (1 OF 3)

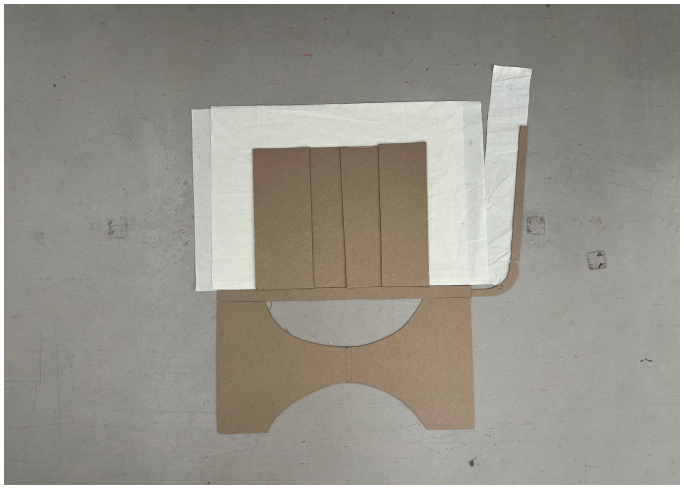
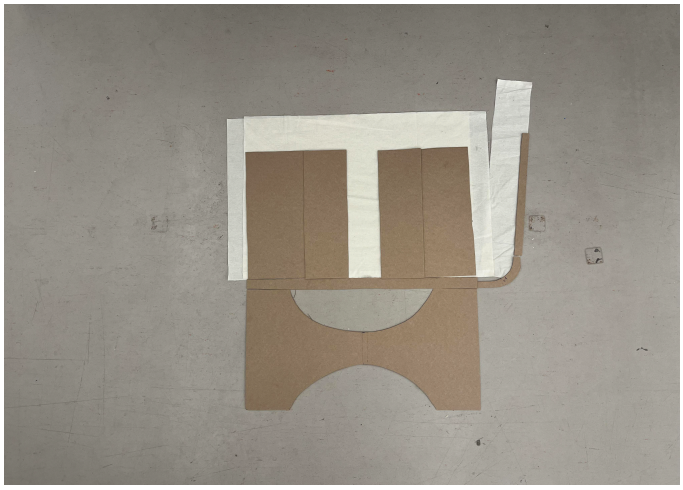
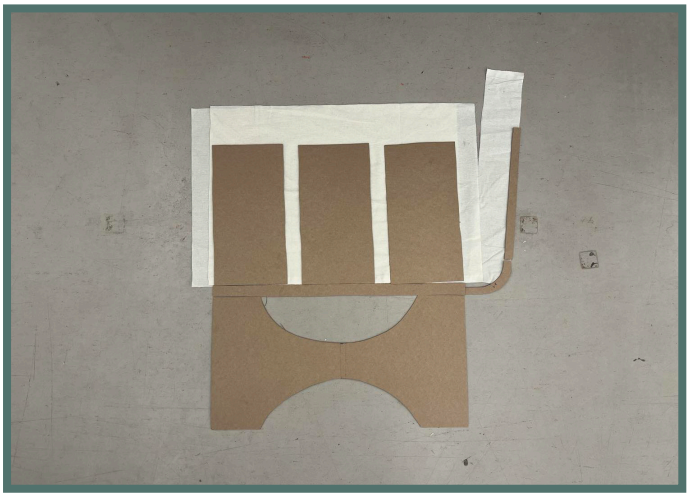
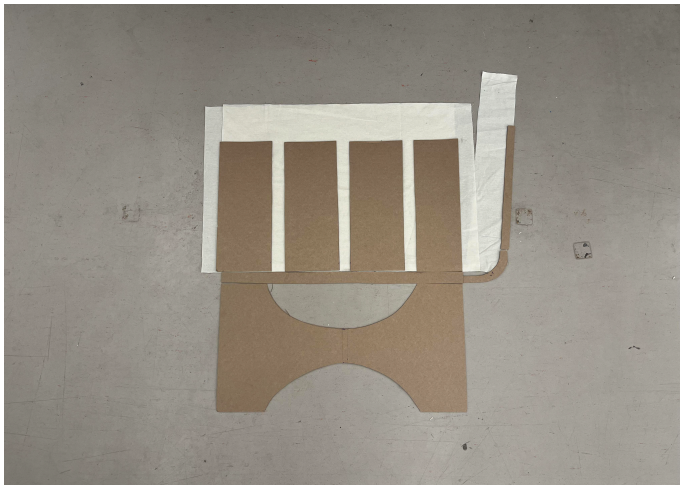
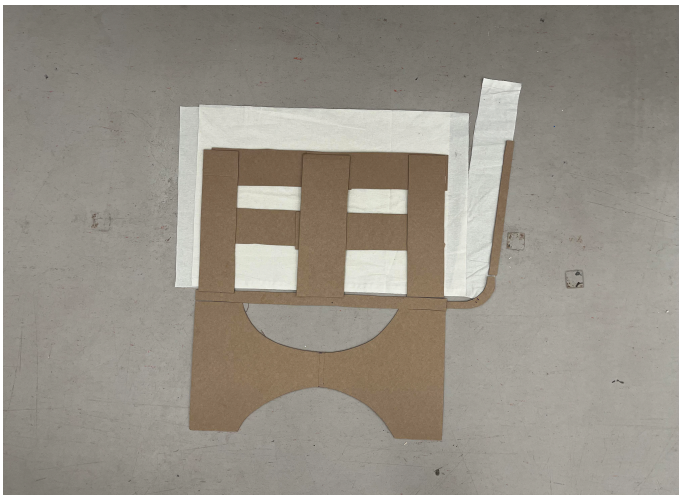
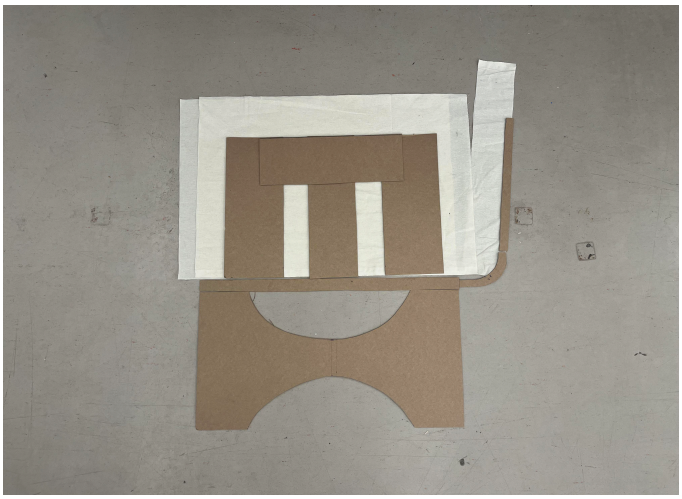
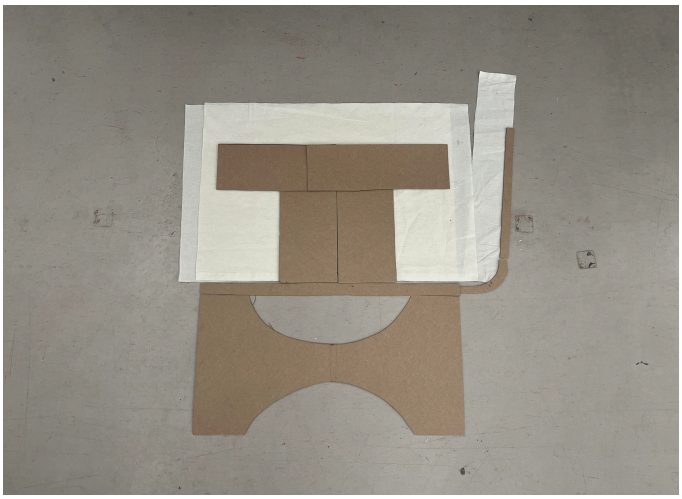
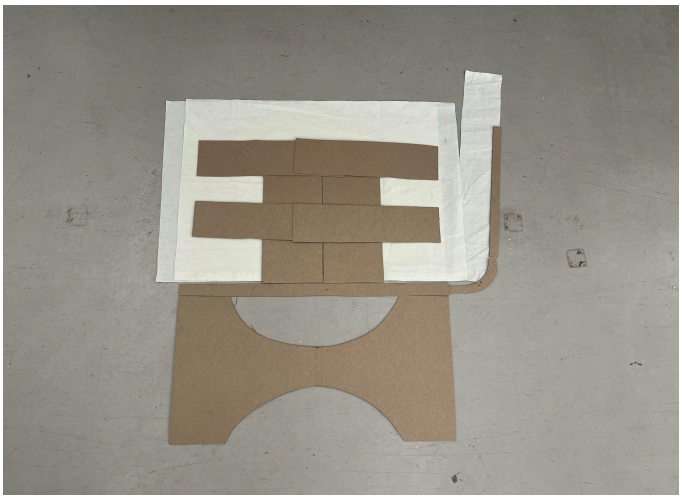
HOW SHOULD THE SLATS LOOK?

The slats provide the sofa back's main flexibility and a big part of its comfort, aesthetics, and uniqueness.

Here I looked into many different shapes for the slats.

I ended up choosing that each cushion should have three vertical slats, because it covers the entire area of the cushion in a supporting way. Too many slats would also mean the flexibility would be too firm, and too few would mean that it would be too soft.

The simplicty of just three rectangles gives the sofa a minimalistic look that blends well in with the rest of its shape.

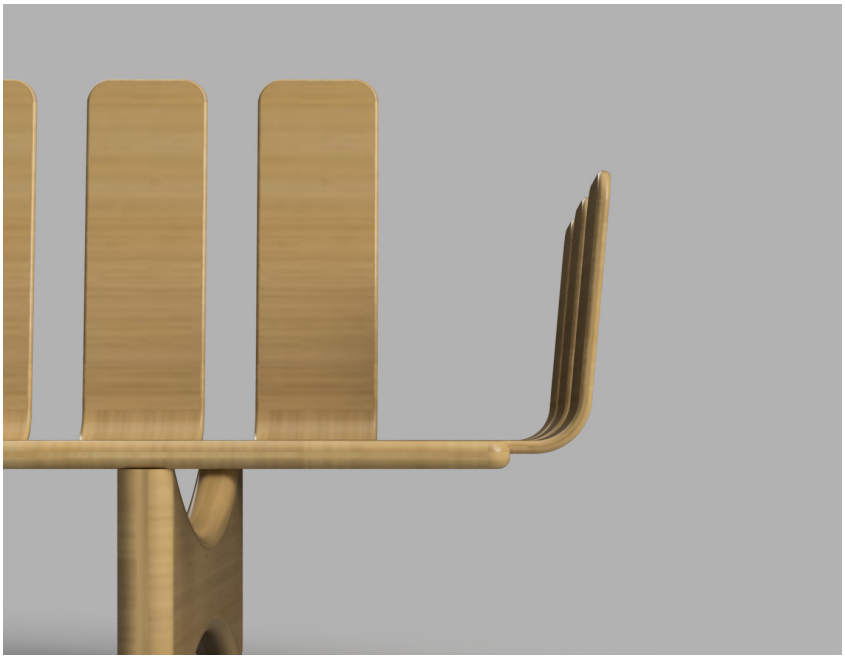









THE BACK & ARMREST (2 OF 3)

SHOULD THE SLATS HAVE AN ANGLE OR NO ANGLE?

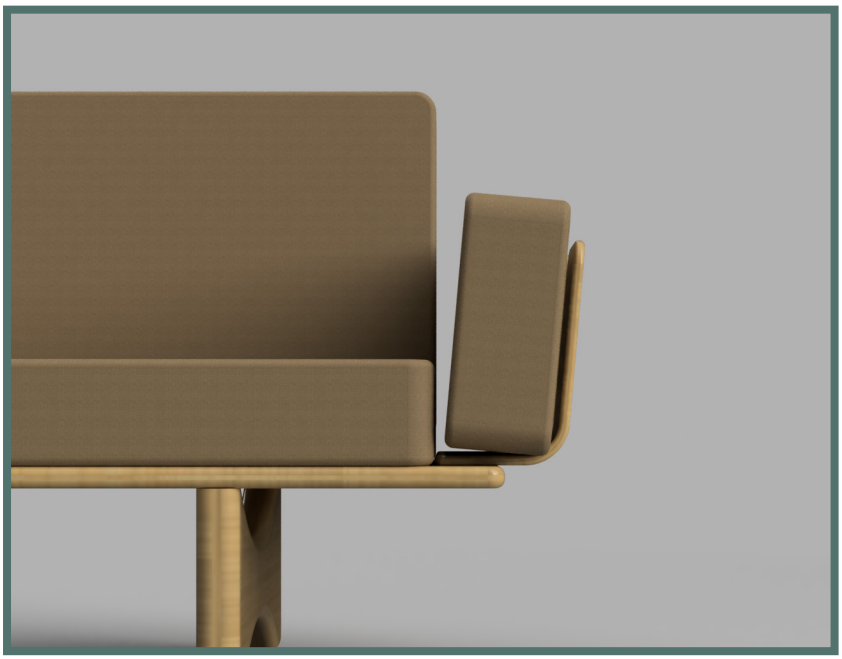
I made two variations of the slats, one where they had an angle of 5 degrees, and one where they were straight. I chose the one with a 5 degree angle because the sofa seems more welcoming with its “open arms/slats”.

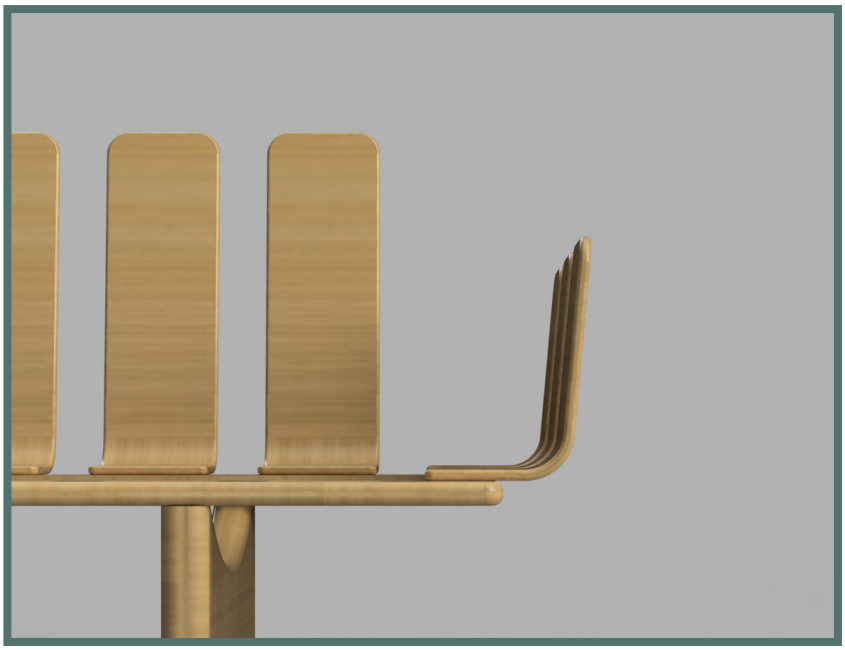
THE BACK & ARMREST (3 OF 3)



SHOULD THE SLATS BE IN, OR ON TOP OF, THE FRAME?

I made two variations of the slats, one where they were lowered into the frame, and one where the slats were on top of the frame. I chose the one where the slats were on top of the frame, because it provides a slight edge that help the seat cushion stay in its position.





THE CUSHIONS (1 OF 3)

SHOULD THE BACK CUSHIONS BE BEHIND OR ON TOP OF THE SEAT CUSHIONS?

There are many combinations of how the seat and back cushions can be placed in the sofa. I chose for the back cushions to be behind the seating cushions, as seen on the pictures below.

Here you an exampel: of the back cushions behind the seating cushions (Inland sofa from the brand &Tradition desiged by Anderssen&Voll)(26)

Here you an exampel: of the back cushions on top of the seating cushions (outland sofa from the brand muuto desiged by Anderssen&Voll)(27)

(26) https://www.scandinavia-design.fr/AND-TRADITION/inland-sofa-anderssen-voll-2022.html
(27) https://aword.no/produkt/muuto-outline-sofa-3-seter-fiord-0961-gronn-sort-base/

HOW SHOULD THE ARMREST AND BACK CUSHIONS MEET?

There are many combinations on how the armrest cushions should meet the back cushions.
I chose for the armrest cushions to be flush with the back of the sofa. In that way it was possible to make all the cushions exactly the same length. An identical length also means that there would be the same spacing between the slats.

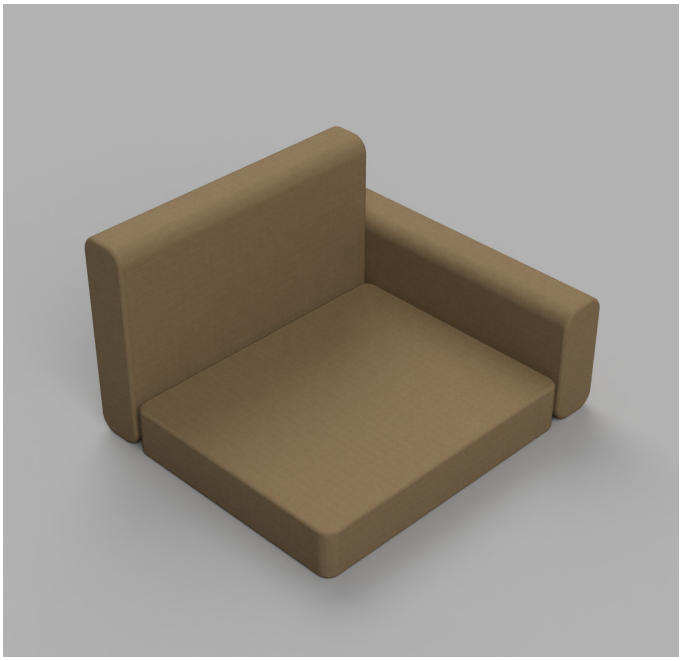
Here the armrest cushion is flush with the back.

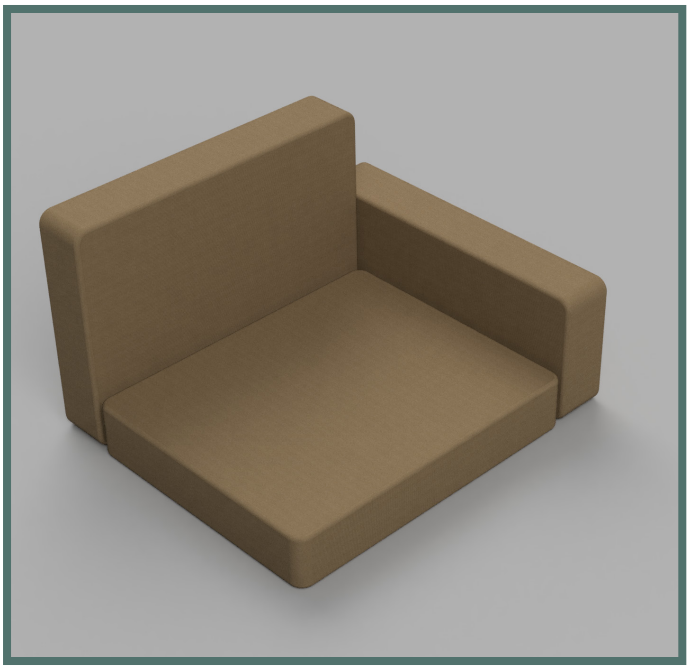
Here the armrest cushion is shorter.

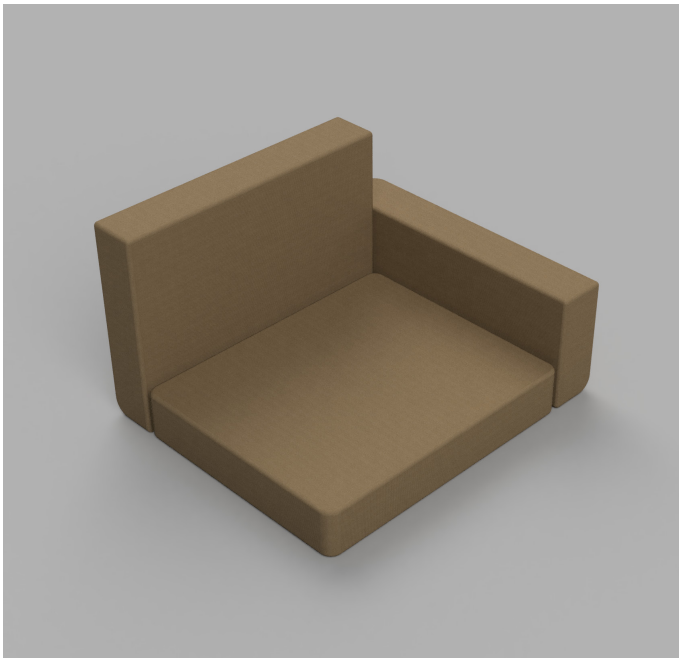
THE CUSHIONS (2 OF 3)

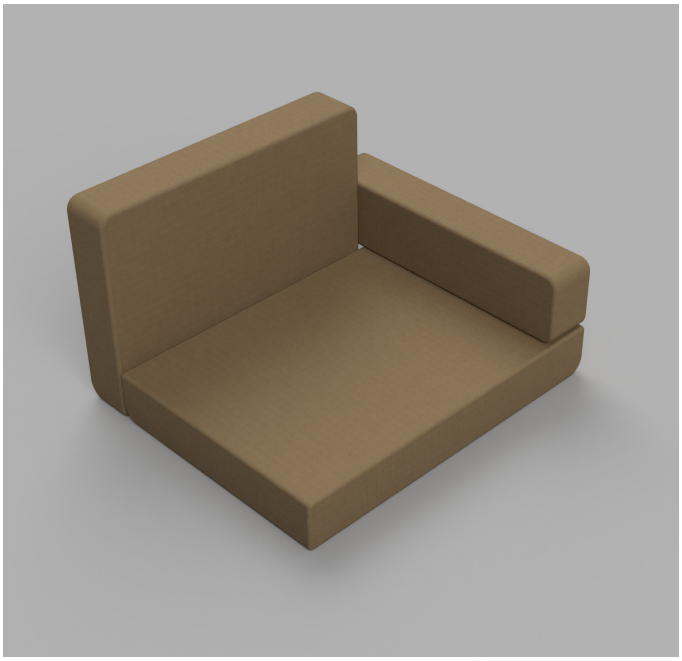
HOW SHOULD THE CUSHIONS BE SEWN?

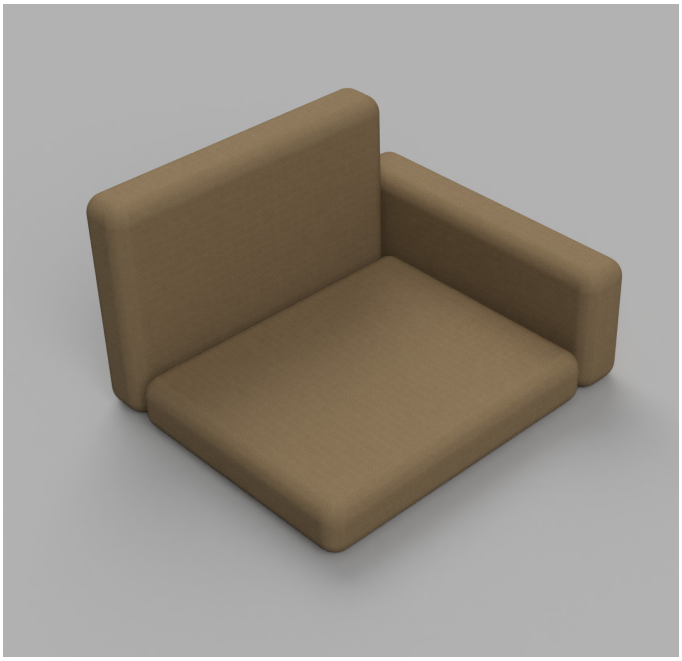
If you look at my ideation of how cushions should be sewn, the six variations don't seem to vary by much. But the difference is in how the corners and edges are formed. I chose this sewing after talking to Eddie King. He said that this is the regular way of sewing cushions, and people often want what's simple and familiar.



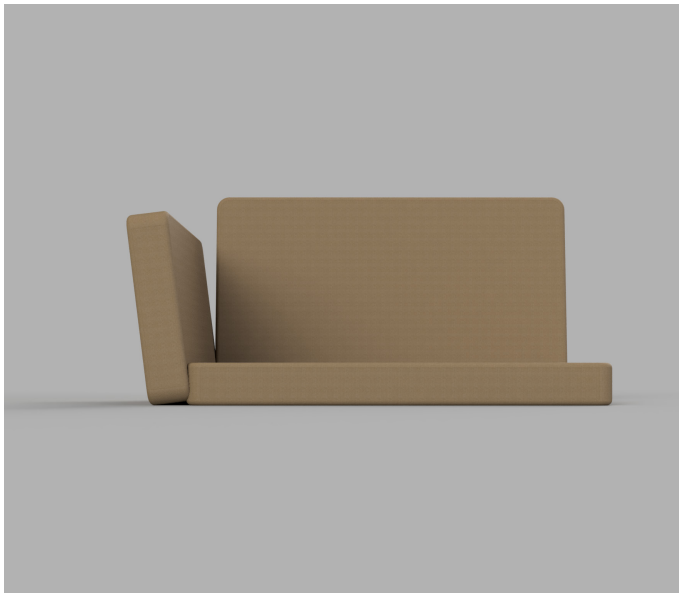








THE CUSHIONS (3 OF 3)

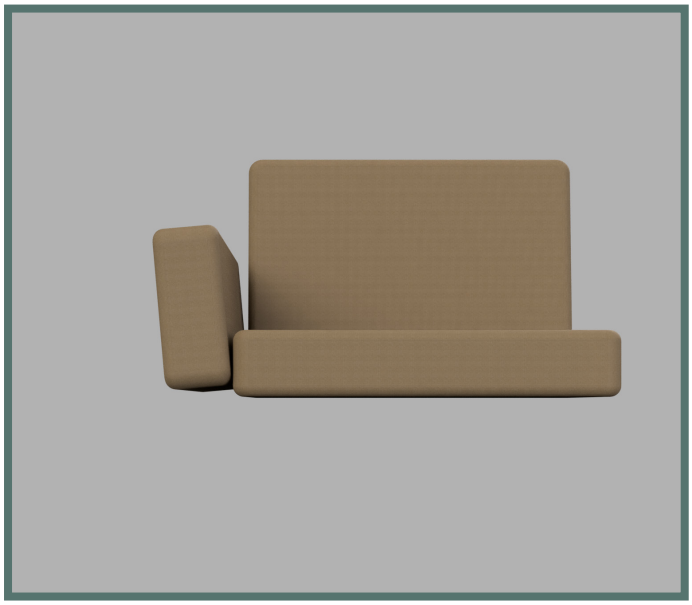


OVERALL IMPRESSION

After I have chosen all the components for the sofa, I made two variations: one where the cushions have half of their normal amount of stuffing and one where the cushions have the normal amount of stuffing.

When you change the amount of stuffing, you also change the hight of the cushion. When you change the hight of the cushion, you also change the overall dimensions of the sofa. It's all connected like a puzzle that needs to be solved in an aesthetic way.

By changing the amount of stuffing and hight of the cushions, the sofa gets too much spacing underneath the frame, which makes it look more like a bench, and not a sofa. I also showed the two variations to my classmates and they agreed: they would only buy the sofa if it had the normal amount of stuffing.



CHAPTER 5 CONCLUSION

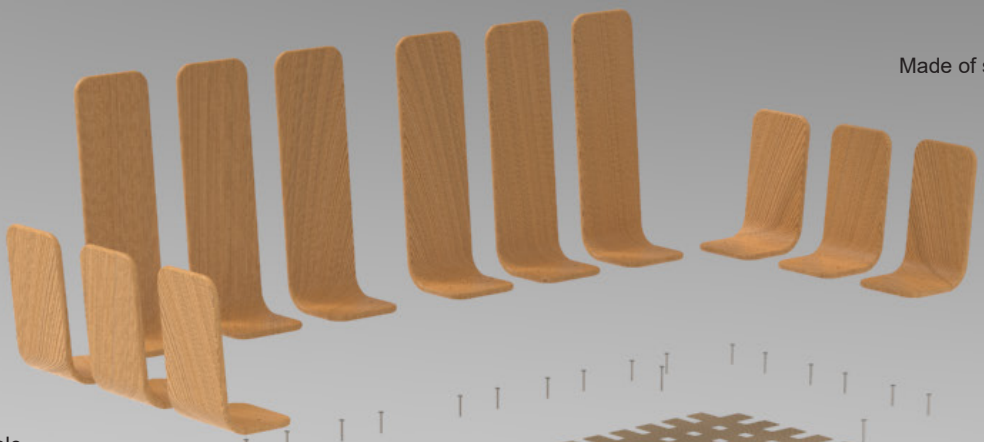
To the left: here you see how the sofa is assembled, and you get the overall impression of the design.

To the right: here you see the sofa disassembled, and all its components, and what they are made of.

The entier sofa is made of basic, organic, biodegradeable materials, and it has a simple and friendly look.

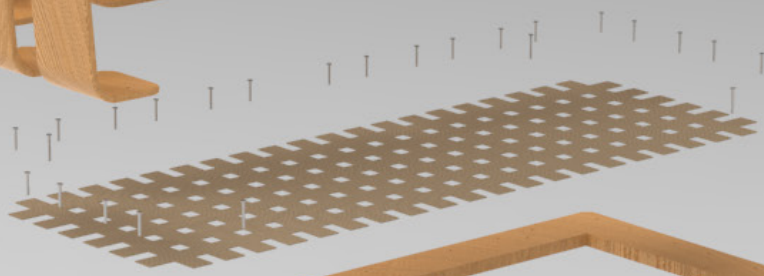
CUSHIONS
Made of linen textile
& hemp stuffing

SLATS
Made of steamed oak



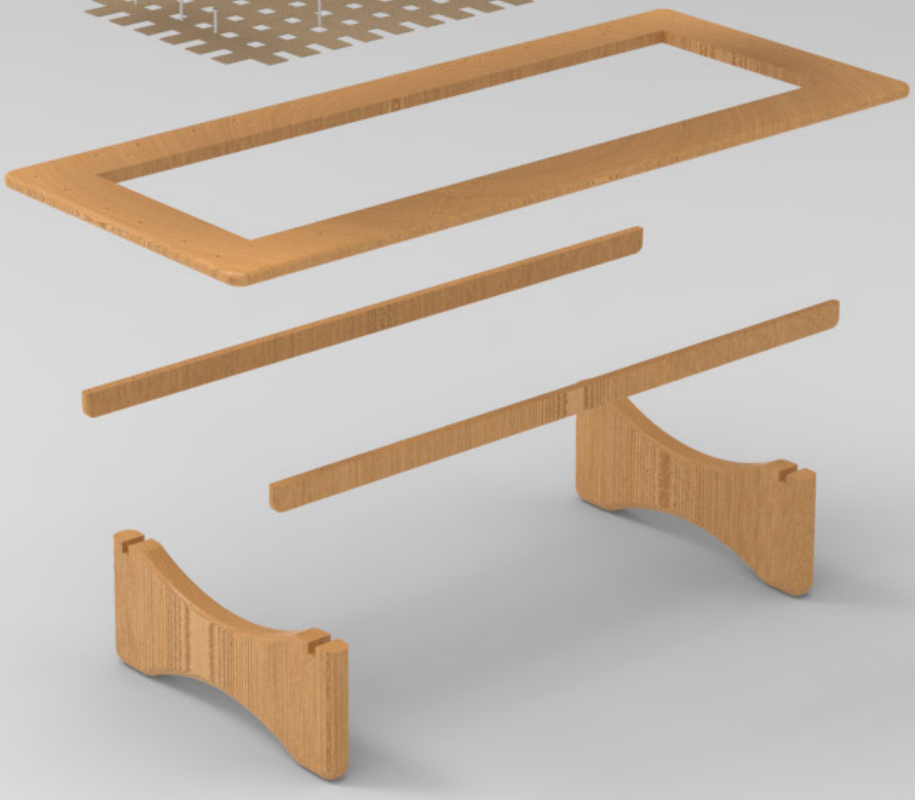
SCREWS
Made of biodegradable
plastic

RIBBONS
Made of hemp



FRAME
Made of oak

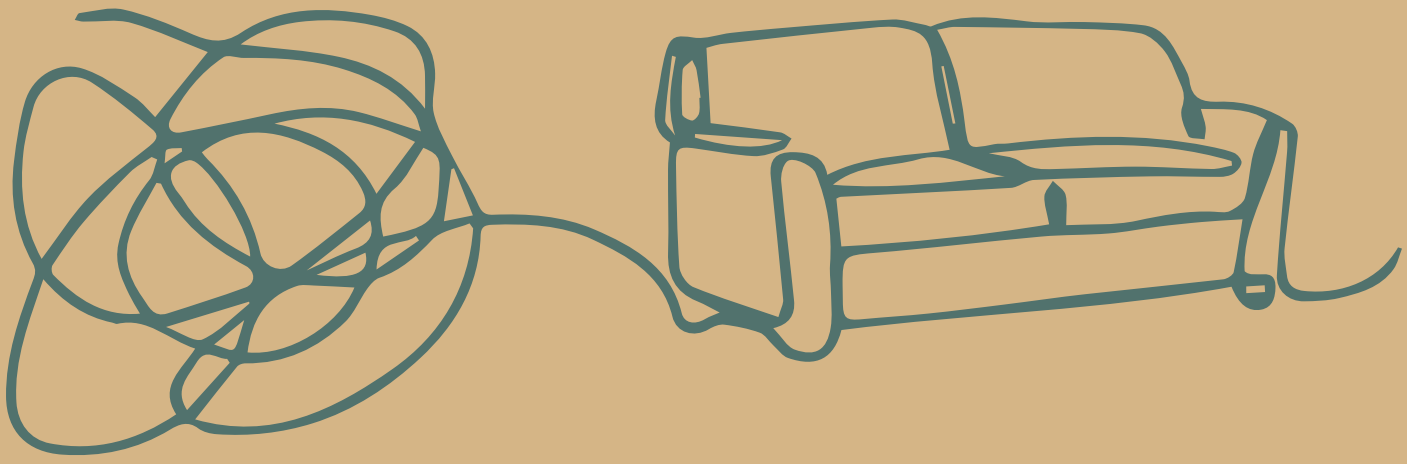
BEAMS
Made of oak



SOFA LEGS
Made of oak

CHAPTER 6

PRODUCT RESULT & TEST



THE FINAL REVEAL

In this last chapter you see the revealing of my sofa, and the final usertest to test my three working prototypes. This last chapter is going to consist of 3 steps:

STEP 1:

A product presentation, where you can see and read about the sofa and its details.

STEP 2:

The final test where i have tested my working prototype on 10 users.

STEP 3:

A conclusion and reflection of this entire diploma project.

A biodegradable sofa

BASIC - A SOFA FOR THE HOME

Hello! Meet BASIC the sustainable sofa for the home. If you want a reliable, solid, and durable sofa that stays with you through life, this is the one!

BASIC has a very good comfort with its cushions made of hemp, and its flexible construction.

BASIC has a construction with few components, designed for disassembly, so it can be flat-packed during transportation and easily repaired through its life time.

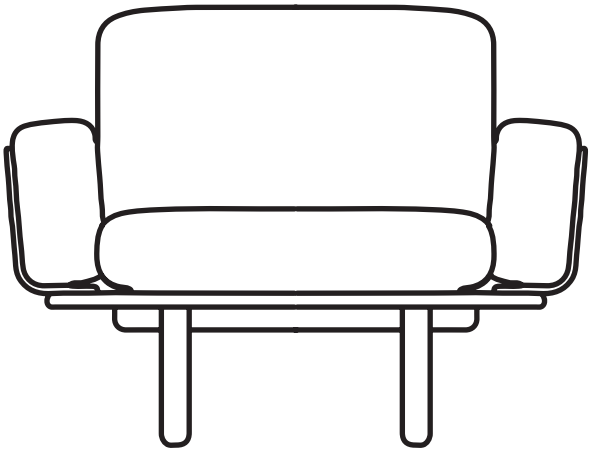
BASIC is made 100% organicly with all biodegradeble materials. That means you can basically throw the sofa out in your garden and it will decompose within a year and become fertilizer for your plants.

BASIC *brings people together*

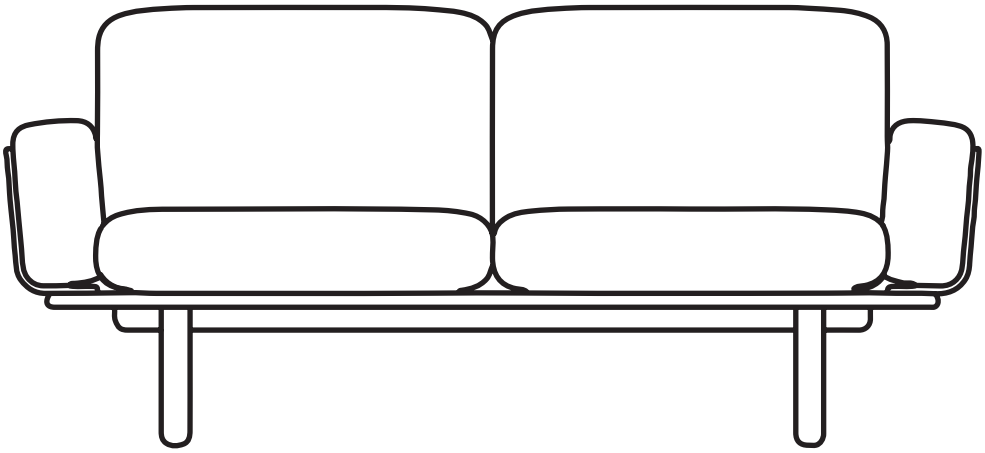
BASIC *gives you time to relax*

WHAT FITS YOUR HOME:
1-2-3 SEATER ?

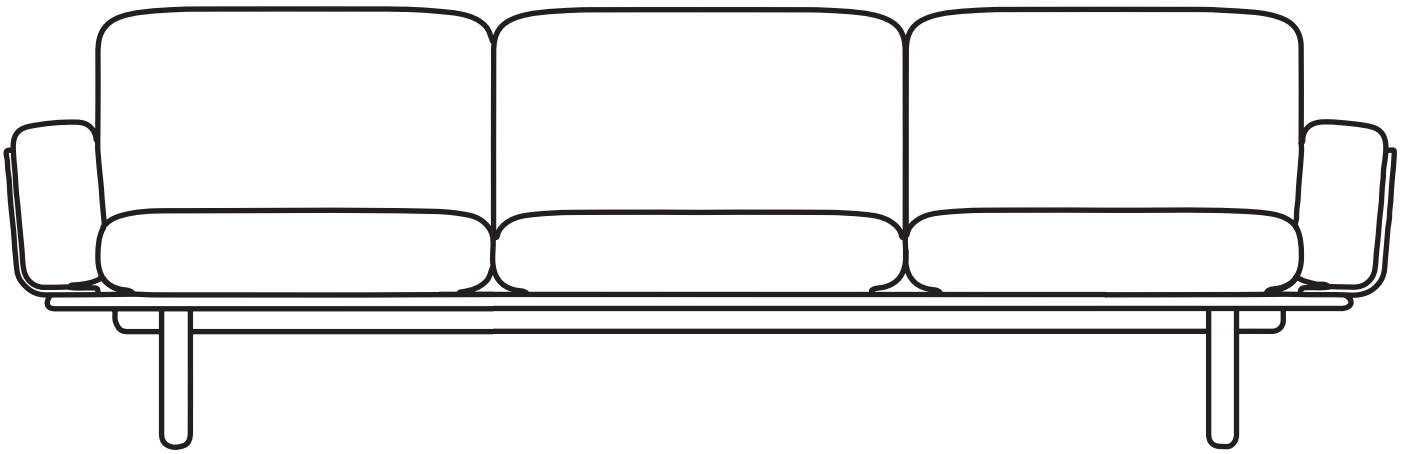
102 cm

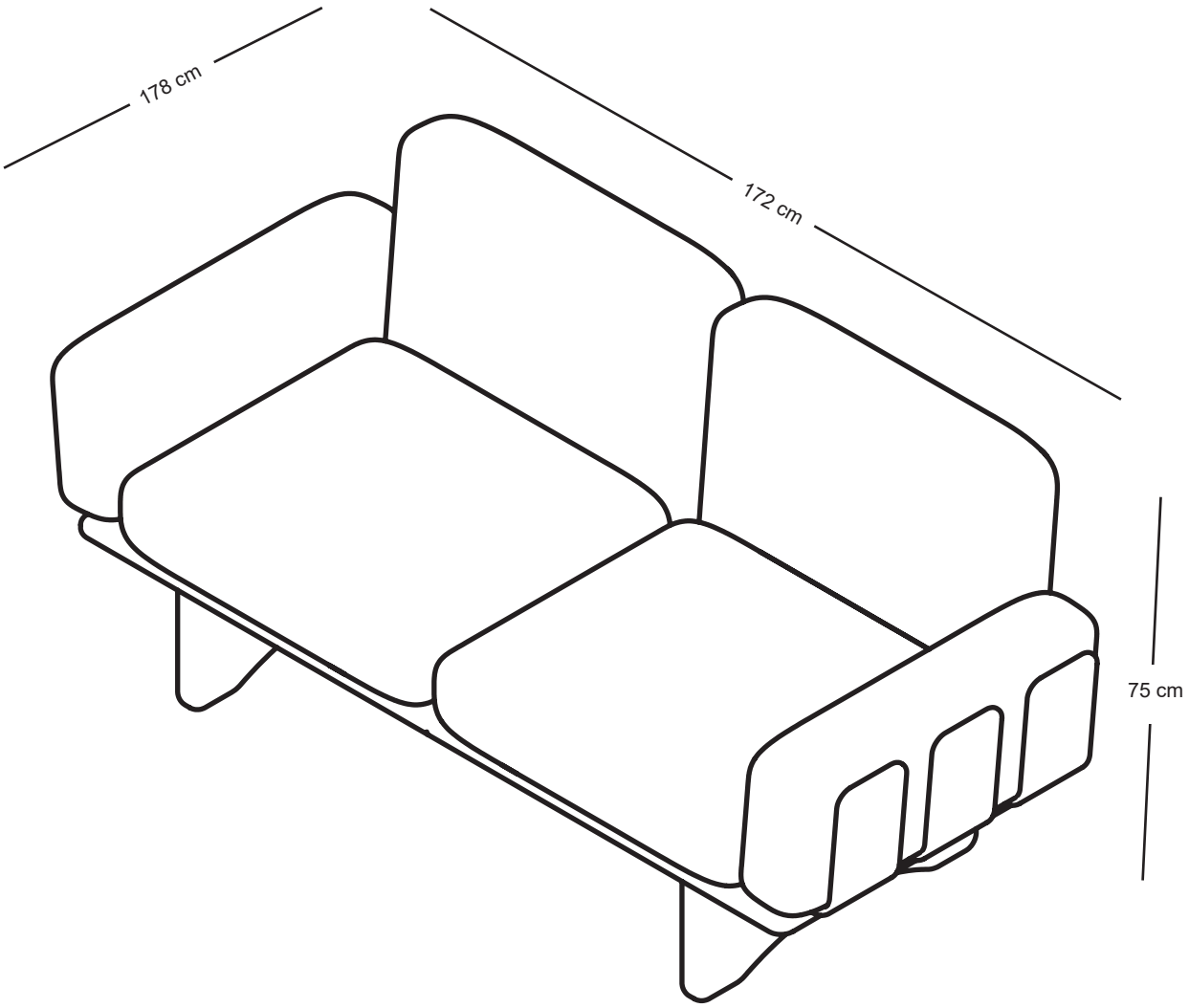


172 cm

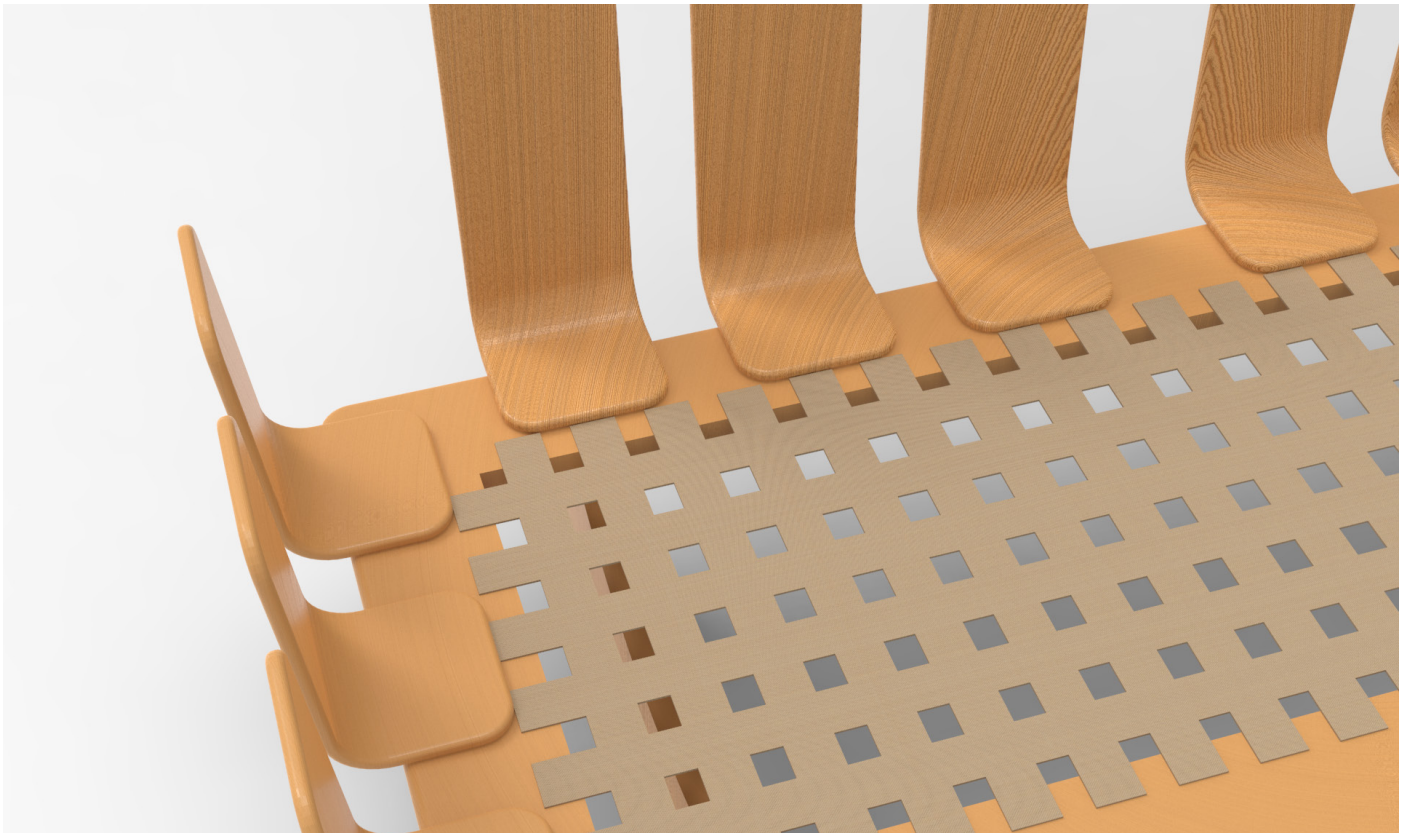


242 cm




178 cm
172 cm
75 cm

DETAILS



Flexible hemp ribbons provide good comfort in the seat.

Functional legs, that provide space for the flexible hemp ribbons and also look beautiful.

Flexible slats provide good comfort in the back.

Screws that are made of biodegradable plastic.

THE FINAL TEST

WHAT I'M GOING TO TEST:

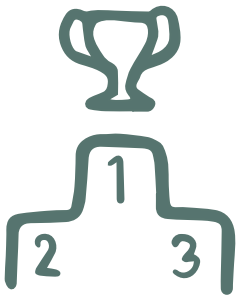
In this final test I have tested the comfort of my two chosen plant fibre cushions and one reference foam:

1: HEMP
2: HEMP / WOOD WOOL
3: FOAM WE35

HOW I HAVE DONE THE TEST:

I have tested them on a working prototype, with the same flexibility and dimensions of my final designed sofa. I have collected the final feedback for the comfort of the 3 cushions in 3 ways:

1: with user tests of 10 users with no knowledge to the project.
2: with feedback from Eddie King, the upholsterer that made the cushions.
3: with feedback from world famous furniture designer Anderssen&Voll.



Here you see one of my 3 sets of cushions used in the user test.

Here you see my working prototype, with my chosen flexibility.

THE RESULTS

FIRST REACTIONS ON EACH OF THE 3 CUSHIONS' COMFORT

1: HEMP	2: HEMP / WOOD WOOL	3: SYNTHETIC FOAM
ANSWERS: Good and nice. Look like soft but it's not. Firm, and look compact. Comfy, but you feel the base. Feel like Japanese futon. Quite hard. Hard in seat, good in the back. A bit hard, but comfortable. Comfortable as first impression. Firm and nice, not to soft	ANSWERS: Worse, harder than the first one. To compact, and noisy. The worse one. Much more hard, not as good. Not to bad, I liked it. Hard after some time sitting. More flexible and more sound. Same as the first, but a bit harder. Feels more sustainable, noisy. A hard waiting room sofa.	ANSWERS: Soft and nice. Prefer this one. I like it, the best one. Full comfort in the body. Most comfy. More relaxed, a bit comfier. It good for the back, and comfy. Very soft. The best one very comfy. Extreme soft, like a lounge sofa.

In this chart you see my 10 users with no prior knowledge to my project, first time trying out my 3 working prototypes (without knowing witch material is in the cushion). Here you can see their first reaction and comments on each of the 3 working prototypes they tested. When reading the comments on each, it's easy to see that the users like "SYNTHETIC FOAM" as number 1, "HEMP" as number 2, and "HEMP / WOOD WOOL" as number 3.

DO YOU FEEL ANY DIFFERNCE IN COMFORT FROM THE 3 CUSHIONS?

YES	NO
IIIIIIIIII (10 users said yes)	

After my users had tested the 3 working prototypes, I asked them if they felt any difference in the comfort of the 3 different cushions they tested. Here, all 10 users agreed that there was a significant difference.

WHICH OF THE 3 CUSHIONS WOULD YOU PREFER TO HAVE IN YOUR SOFA?

1: HEMP	2: HEMP / WOOD WOOL	3: SYNTHETIC FOAM
IIII (4 users prefer "HEMP")		IIIIII (6 users prefer "FOAM")

After I asked the users which of the 3 working prototype cushions they would prefer: 4 users prefered "HEMP" 0 users prefered "HEMP/WOOD WOOL" and 6 users prefered "SYNTHETIC FOAM".

WOULD YOU CHANGE YOUR MIND IF I TOLD YOU THAT THE CUSHIONS 1 AND 2 ARE SUSTAINABLE AND 3 IS NON-SUSTAINABLE?

1: HEMP	2: HEMP / WOOD WOOL	3: SYNTHETIC FOAM
IIIIIIII (8 users prefer “HEMP”)		II (2 users prefer “FOAM”)

In the end of the user test, I gave the user the information about what material was inside each working prototype cushion, that: 1 and 2 were made of sustainable materials and 3 was made of non-sustainable materials. After this given information 4 users change there mind, from choosing non-sustainable “SYNTHETIC FOAM“ to sustainable “HEMP“. I can conclude after this last usertest that people are willing to give up less comfort for a more sustainable solution.

FEEDBACK FROM EDDIE KING FURNITURE UPHOLSTERY

All my final adjustments were done in Eddie King’s upholstery shop, where he had the 3 sets of cushions finished. He also helped me with the mounting of the hemp ribbons for the 3 finished functioning models I have built in AHO’s workshop. So, Eddie was actually the first person to test the 3 variations.

He said that he was surprised and had to say that the “HEMP“ cushion gave better comfort than the cushion with “HEMP/WOOD WOOL“.

He thought the cushion with “SYNTHETIC FOAM WE35“ gives a better comfort, but a “HEMP“ cushion could be a possible alternative.

FEEDBACK FROM FURNITURE DESIGNER ANDERSSEN&VOLL

Anderssen&Voll’s first impression when sitting in the “HEMP“ cushions was that it was hard at first, but after sitting on “HEMP“ for a while it felt more comforting and they also thought the firmer sitting gave it an organic feel. They said it would be interresting to test the cushion in real durability test machines, to see if it retains volume and firmness over time.

They didn’t think “HEMP/WOOD WOOL“ had as good comfort as “HEMP“ but they suggested that it would have been interresting to test out “BAMBOO WOOL“ which is seen as more durable and softer.

The “SYNTHETIC FOAM WE35“ was their favorit. It has the comfort a sofa needs. They also didn’t think my solution of “HEMP“ fibre in a cushion would be a replacement for foam, but a good starting point. They think that the solution could be in using “HEMP“ because its one of the strongest plant fibres, but make it into an organic latex, which is more like the foam we know to day.

CHAPTER 6 CONCLUSION

MY DIPLOMA JOURNEY

It has been a long, hard, but also interesting diploma project, and I am proud of what I have achieved. With the time given for this diploma project I could not have reached more than I did, but when that is said: a project and a topic of this size will never be solved in a short time period, it would take years of research and testing.

I see my diploma project as similar to a fashion show. The clothes the models are wearing on the catwalk are often percieved as bizzare and unconventional. But, the idea is not that the clothes are meant to be worn in the present, rather they are conceptual statements, to inspire the future trends to come.

So, I see my diploma project together with much other research done on the topic of replacement for synthetic foam, as an inspiration for more to come, and hopefully one day, the solution will be invented.

If I had more time on this project, I would have tested much more plant fibres. There is an entire world of different plants you can make fibre from with different qualities to explore.

I would also have done all my testing on full size cushions and tested them with proper equipment to get an exact assessment of the durability.

I would also have done a more substantial ideation of my sofa construction, and on all its components, to see if there was a better solution. To put a sofa on the market takes many working prototypes with testing, where you do small adjustments on the way.

After the sofa would be built and put in production it would also be possible to make life cycle assessments to see the entire environment impact of the sofa, and see the the difference from a regular sofa made of synthetic foam.

I would say that the future potential for this project also would be to find the industrial manufacturing procedure to make the hemp cushions of fibre. But also, to look in to the possibility of making hemp into an organic latex that looks more like the foam used today.

I will end this conclusion and reflection on my diploma project by saying:

You should see it as building a house, destroying it, and rebuilding it. The second time you build it, it would be a better built house, because you have the knowledge from building the house the first time. So, no matter how many times you build and destroy the house, it will always improve the next time around.

I WANT TO SAY A SPECIAL THANKS TO:

Hilde Angelfoss - for being my supporting superviser and guide me through this project

Anderssen&Voll - for giving me usefull insight and feedback on my project

Eddie King - for helping me make the working prototype sofa cushions

The teachers of AHO's workshop - for guidance through the wood construction process

All the users - for helping me collect usefull data throug testing

Henrik Smedal Olsen - for proofreading

THE END