Design for Chaos

Flat-packable Furniture Designed for Transit Lifestyle

Degree Project
Master of Industrial Design

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FACULTY OF ENGINEERING

Design for Chaos

Flat-packable Furniture Designed for Transit Lifestyle

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Degree Project for Master of Fine Arts in Design
Main Field of Study: Industrial Design

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Abstract

Inspired and influenced by the times of chaos, this Master's degree project investigates how users and manufacturers survive in this disorganized, unstable, and even frightening living status. The result, ***Chaos***, is a furniture collection designed to maximize flexible production and usage.

Keywords: Flat-packable, furniture, design for chaos, transit lifestyle

Table of Content

1. Introduction

1.1 Initial question

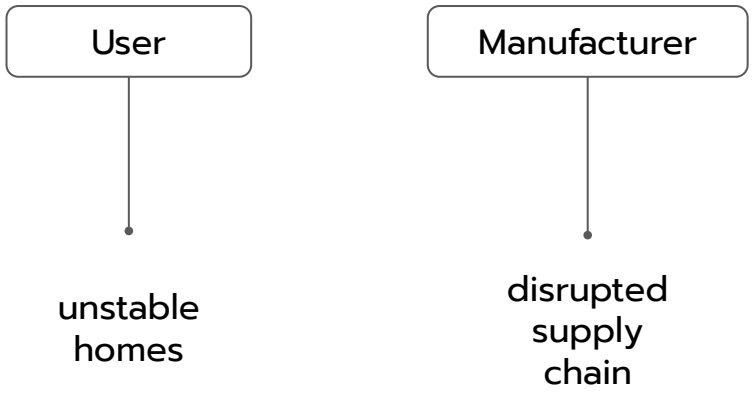
What does the furniture look like in times of chaos?

We're diving into an age where supply chain disruptions, economic crises, and even wars are just around the corner, if not happening. We try to imagine the global manufacturing network as a dynamic net that has become somewhat broken and porous due to these complex situations. Our questions would be, **how can we fix these holes with design solutions and innovations, if we should? How can furniture design adapt to this new normal?**

1. Introduction

1.2 Background

What is chaos?



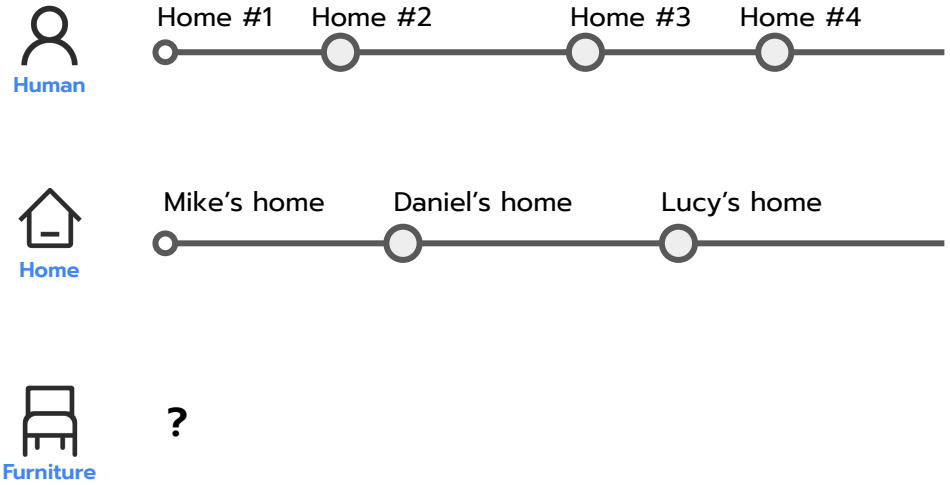
The disorder takes place simultaneously in both individuals and manufacturors.

We analyze separately: investigating how **users** would adapt to their unstable homes, and also how **manufacturers** would address the chaos if the supply chain were disrupted.

2. Research & Analysis

2.1 User research

Chaos is unstable homes.



For individuals, chaos is their **unstable homes**. In our whole life, we would live in many homes, rent different houses and choose to live in different places.

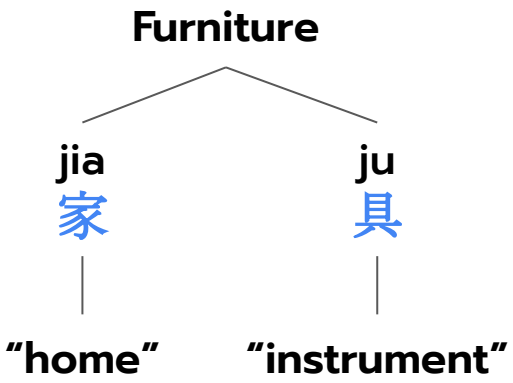
If we are in this constantly moving state of living, **what would our furniture look like?**

2. Research & Analysis

2.1 User research

Chaos is unstable homes.

Changing town
Studying or working abroad
“Apartment hopping”
“Urban nomads”
...



The definition of "furniture" is somewhat different than it used to be if we **kept moving**. Either because we choose to go to another place or even go abroad for better opportunities for education or work.

In Chinese, the term "家具, jia ju" refers to furniture. However, if we translate it directly into English, it should mean "home" and ”instrument”. If we no longer consider our temporary residence a **real home**, the form of furniture should also change.

2. Research & Analysis

2.2 User research: a survey of moving home

“How would you deal with your old furniture when you move home?” (Sample: 14 participants)

International students: 7

50 %

Swedish students: 4

28.6 %

Graduated and working people: 3

21.5 %

We conduct a survey to find out how people dispose of their furniture when they move. The results reveal that no matter what they decide to do with their furniture, it would always be **moved to a new "home"**.

2. Research & Analysis

2.2 User research: a survey of moving home

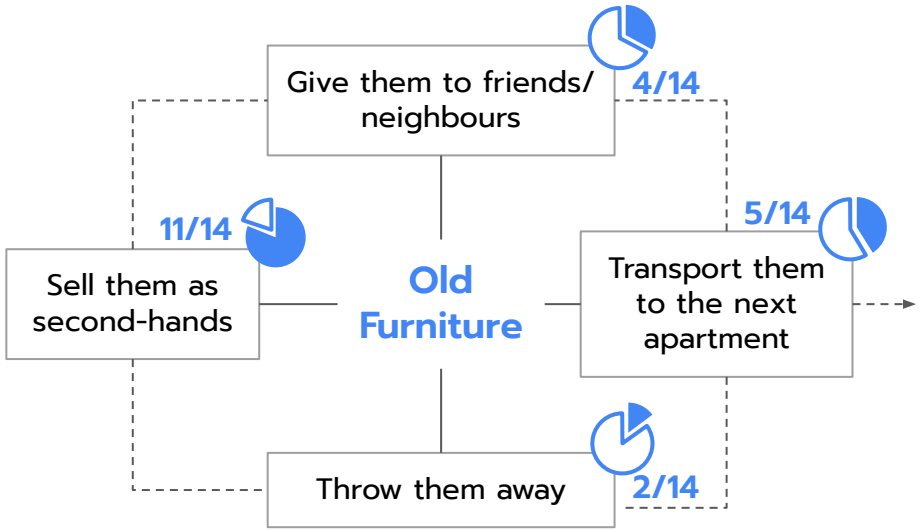
"How would you deal with your old furniture when you move home?" (Sample: 14 participants)

1	I took them to the second-hand store, but I bought the same chair in my new apartment.
2	I left the sofa and the bed with the landlord, probably still in the old apartment, and I sold the rest of the stuff.
3	I sold them and gave the rest to my friends.
4	I sold my floor sofa but as I liked it so much, I made a similar one myself in my new flat.
5	I am moving and since I will not return to this country, I am selling or throwing them in the recycling room.
6	I gave them all to friends.
7	I sold them on Facebook.
8	My new home is right next to the city, so I hired a van to transport them all there.
9	I gave some of them to my neighbors and sold the rest.
10	Most of them were sold, and the rest were put in the recycling room.
11	I worked in Gothenburg after I graduated, so I sent all the small pieces there and sold the big ones.
12	Most of them moved back home, the rest were put in the second-hand store
13	I sold most of the furniture, some small pieces that I liked I brought them to my new home.
14	Some of them I brought from home, so I took them home after graduating.

2. Research & Analysis

2.2 User research: a survey of moving home

Conclusion

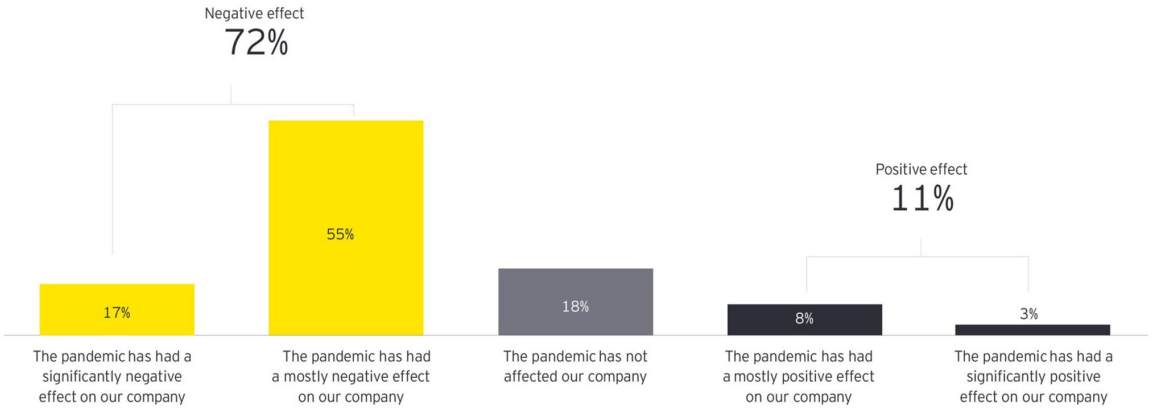


The results reveal that no matter what they decide to do with their furniture, it would always be **moved to a new "home"**.

2. Research & Analysis

2.3 Market research

Chaos is the disrupted supply chains.



Note: Some charts add up to more than 100% due to rounding

Harapko, S. (2021). How COVID-19 impacted supply chains and what comes next. *Ernst & Young*, *18*, 2021.

According to a 2021 study, the lockdowns in different countries slowed or even **stopped** trade in raw materials and finished products.

As a result of this unforeseen and unexpected **global crisis**, **manufacturing is disrupted**.

2. Research & Analysis

2.4 Market research: the interviews in Stockholm Furniture Fair

Location: Stockholm Furniture Fair

Date: February 7th-8th

Interviewees: Furniture companies (Carel, MAZE, ROOLF, Artek, Byarums, EILERSEN, etc)

We looked into the **furniture industry** and tried to find design opportunities. We talked to companies in Stockholm.

The aim of this study was to find out what problems they have faced because of the **pandemic** and the **war**.

2. Research & Analysis

2.4 Market research: the interviews in Stockholm Furniture Fair

MAZE x PILKE	"Companies could not buy pine wood from **Russia and Ukraine**, so they have to purchase **more expensive materials**. The cost of material went up."
ROOLF (Belgium)	"Raw material and furniture were stored in our own factory and warehouse. People preferred to stay at home **due to the epidemic, sales grew 51%**."
Artek	"No more Plywood from Russia and Ukraine so the price is rising in Finland. But ARTEK uses another kind of wood so **it wasn't affected by war**"
Carel	"Customers prefer fine grains from wood without imperfect knots, this cause a lot of wood waste. However, knots appears because of **climate change**."
Byarums	"Buy wood from **South Africa** for outdoor furniture. We also use Swedish wood but they are relatively less durable. Energy bill is high because of the need to heat the stove "
EILERSEN	"Our warehouse is located in both Europe and China because **the cost of transportation** is expensive."
Stockholm Lighting co AB	"Sweden companies tend to **source at multiple places** to avoid corruption."

Conclusion

1. **Material sourcing** is the top-mentioned problem according to the companies. **Prices rise** because of the war in the raw material exporting country.

2. Some companies experienced **sales increases** due to the epidemic, but this does not exclude a **survival bias**, as we could not meet the companies that are struggling and couldn't show up at the exhibition. Because it was mentioned multiple times there were fewer exhibitors this year.

3. The size and weight of furniture lead to **the expensive cost of transportation**.

4. Suppliers can not control **imperfections of natural materials**.

2. Research & Analysis

2.5 Historical research

"The house would make no demands for itself and would serve as a background for life in work, with nature as a shock absorber."

— Charles Eames

Case Study House #8

2. Research & Analysis

2.5 Historical research

The famous statement was made to describe the philosophy behind the Case Study House #8, which was completed in the year of 1945. 1940S was a time of chaos indeed, begun with the brutality of WW2 and ended in the clouds of the Cold War.

The project itself was one of roughly two dozen homes built as part of The Case Study House Program, which was initiated by John Entenza.

The theme of the project was to make buildings and furnitures with the materials and technics developed during the war.

Case Study House #8

2. Research & Analysis

2.5 Historical research

The idea of "shock absorber" was also echoed by design objects created by the Eames.

The Eames developed a leg splint during the war using their molded plywood technique. The shock-absorb material helped reduce further injuries of soldiers due to vibration. In 1945, the LCW chair was launched using similar technique. They also used rubber, an important material to the war machine, in many of their iconic furniture pieces.

Eames Leg Splint

Plywood Chair

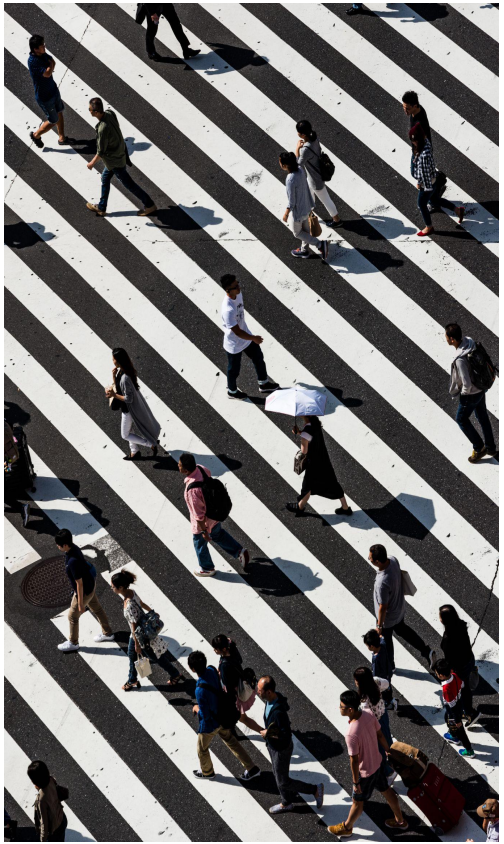
Eames Lounge Chair Shock Mounts

Vitra - Lounge Chair

2. Research & Analysis

2.5 Historical research

Similar to Eames' time, we're also experiencing wars and multiple crisises now. However, our living environment have become much different.



crowding people crossing on pedestrian lane

2. Research & Analysis

2.5 Historical research

We believe the strategy of soothing shocks with the consumption of design should be reconsidered given our situations.

Over the last decades, extravegant but unacessrey products floods the market in the name of “good design” and “good life”. By designing and consuming in such ways, we’re more or less boosting “wicked problems” like global warming, pollution and resource depletion.

“We can’t return to normal, becuase the normal we used to have was exactly the problem.”

2. Research & Analysis

2.5 Historical research

Instead, the return to a “do the bare minimum to make it work” approach and a tolerance for chaotic aesthetics should be advocated. It is more practical to design essential pieces, and to reduce production/ transportation cost. Even though the final pieces may look a bit sketchy.

PUR_PA_02 by Kommer, S.

3 rod connection by Bergheim

SHIFT sofa by form us with love

duplex reel 22

2. Research & Analysis

2.6 Solution 1: for users

“Chaos is unstable homes.”

Our solution is flat-packability and durability.

2. Research & Analysis

2.6 Solution 1: for users

“Packable Objects #1”

2. Research & Analysis

2.6 Solution 1: for users

“Packable Objects #1”

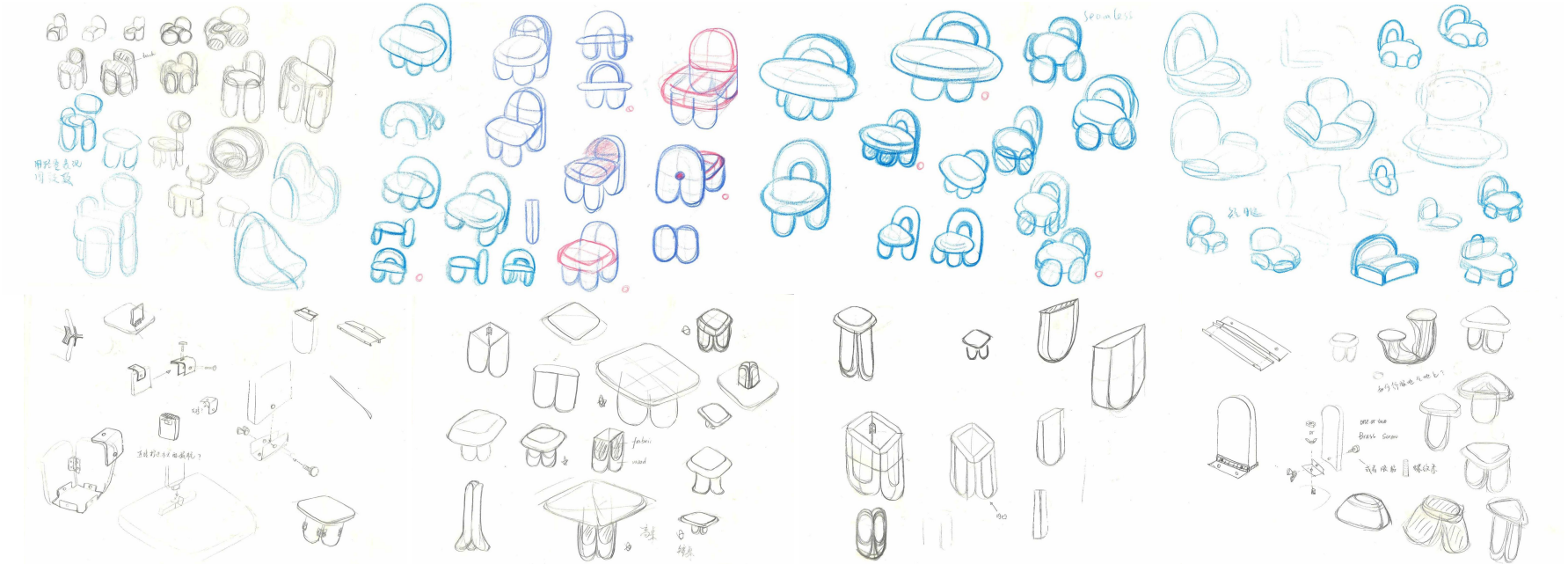
Faced with the hassle of constant moving, our solution is to make furniture that can be **easily taken away** and is **highly durable**.

It could be **easily folded** into a small-sized **tote bag** or wrapped into a **roll**.

2. Research & Analysis

2.6 Solution 1: for users

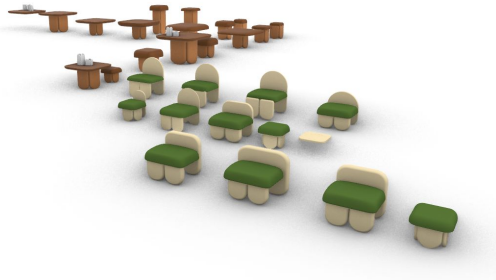
“Packable Objects #2”

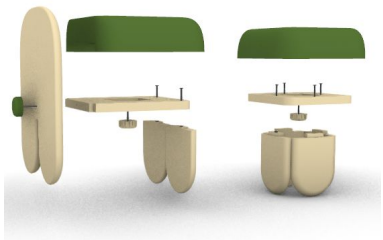


2. Research & Analysis

2.6 Solution 1: for users

“Packable Objects #2”





Our other idea is to make the furniture **easily assembled**. It could be taken apart, fitted into a **suitcase**, and taken to another city.

We believe that furniture purchased from one city is a **souvenir** of that place and **worth taking** to the new "home". It could be of **special significance** and be able to contain **memories** of that life period.

2. Research & Analysis

2.7 Solution 2: for manufacturors

Can brands/ manufacturors enjoy the same level of flexibility as individuals?
Probably yes.

Manufacturor's concerns		Strategies
What to produce	→	Agile development
Where to produce	→	Able to relocate
When to produce	→	Able to control stock
What to producing with	→	Diversed & standardized
How to produce	→	Smaller investment

“Chaos is the disrupted market.”

Our solution is to be able to produced, repaired, and used anywhere. To seize shifting opportunities and be prepared for change.

2. Research & Analysis

2.8 Solution 3: the essentials of life

What are essential pieces for life in transit?

Both sustainability and life in transit require a compact collection of items. So we decided to center our focus on the essentials for this project.

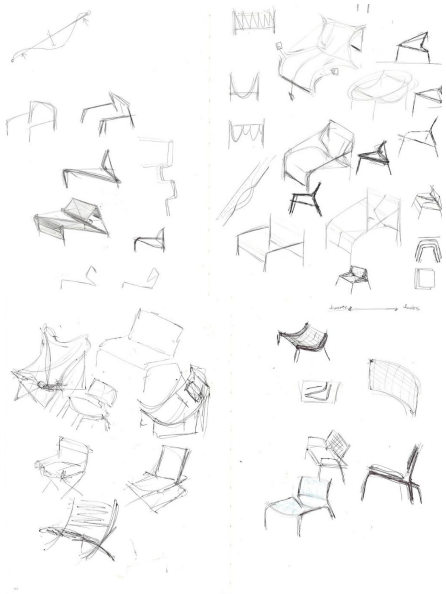
During our whole design process, we spent many hours sitting at the entrance hall of the A-building, usually relaxed, discussing, drawing, relaxing, and reading. Those hours helped us clear our minds and navigate our process. It inspired us to choose a lounge chair and a side table as our essentials.

We all need a corner for ourselves to sit down and relax. Maybe with a book and a cup of coffee.

2. Research & Analysis

2.8 Solution 3: the essentials of life

It all started with a frame and a piece of cloth.



To reduce material, weight, and packaging size, we began to experiment with different ways to make a chair with a piece of cloth and a frame.

3. Design Process

3.1 Design brief

We're diving into an age of chaos. Supply chain disruptions, economic crises, and wars are hitting the news daily. Furniture design can provide solutions for both manufacturers and customers to deal with this situation in a more flexible way.

Chaos is a set of furniture that take advantage of **large-scale** standard materials and celebrate a raw and chaotic aesthetic. **Small-scale** and flexible manufacturing is enabled by minimizing machinery and processes during production. Choosing standard material makes it easier to cope with supply chain complications. The flat-packable design enables flexibility in transportation, repair, and usage.

For users:

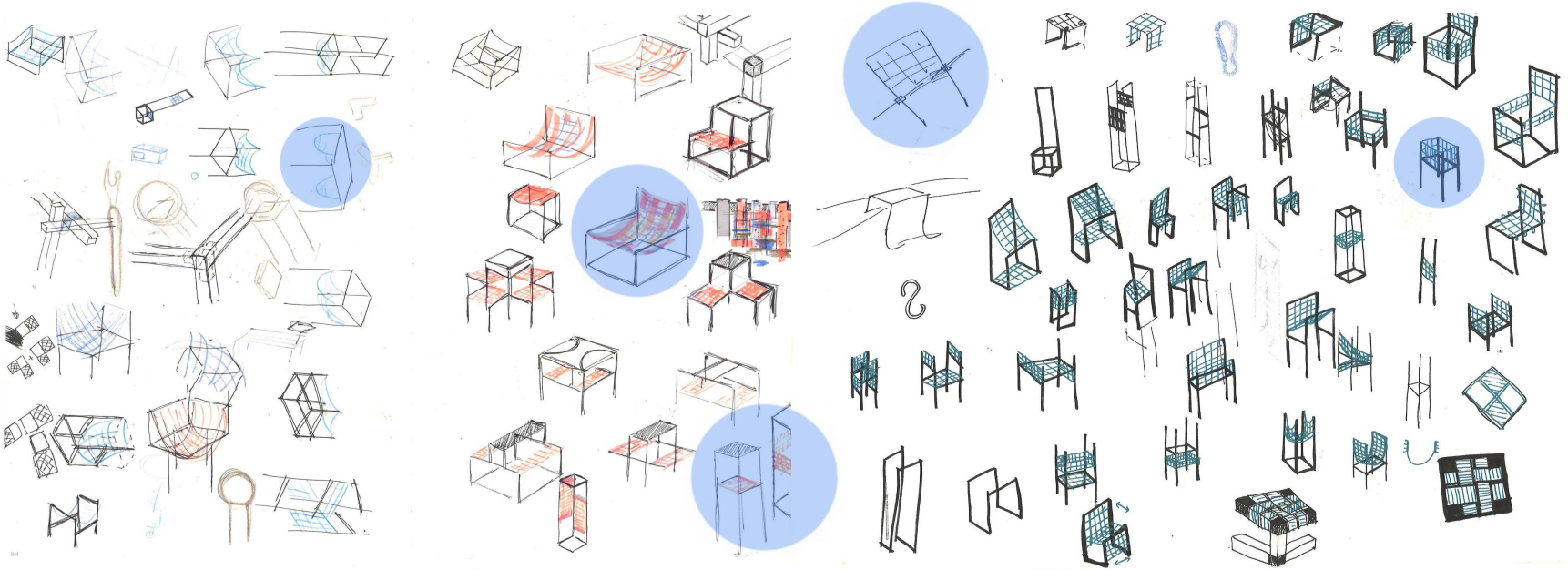
1. flat-packable
2. durable
3. comfortable

For manufacturors:

1. fewer equipment needed to start making
2. fewer time needed for procedures

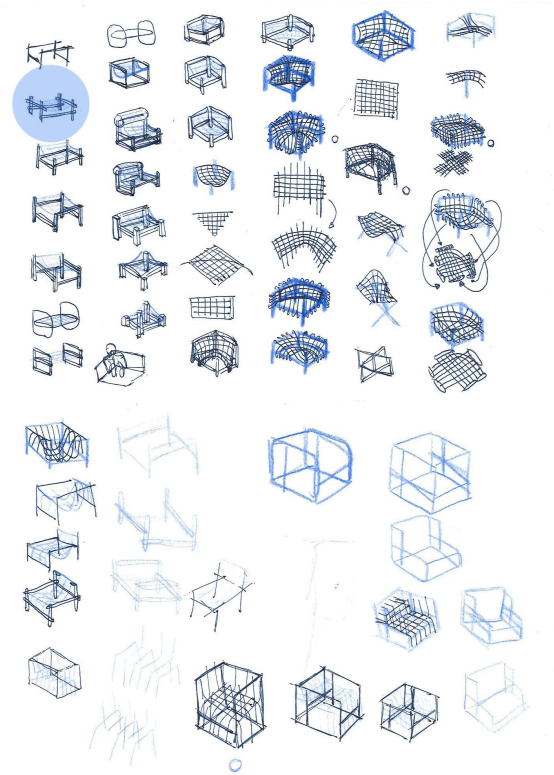
3. Design Process

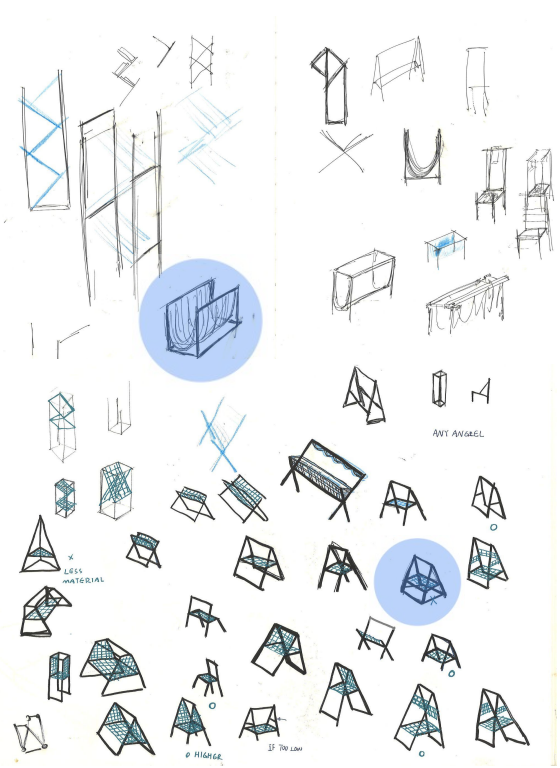
3.2 Sketches

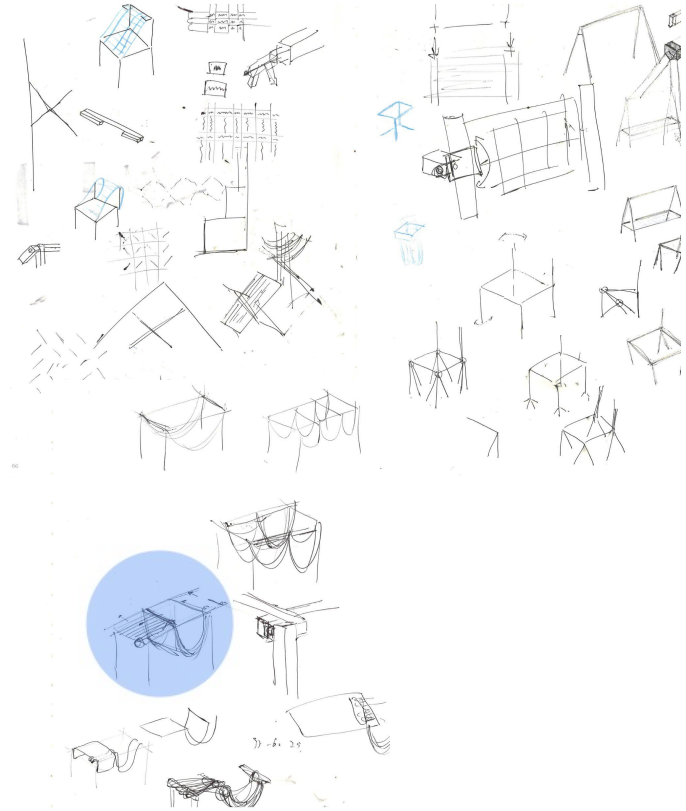


3. Design Process

3.2 Sketches







3. Design Process

3.3 First prototype

We started with a wooden frame and fabric prototype to test its size and usability.

It turned out that the back of the chair and the one-piece fabric were **too deep to support the wrists**. We then developed it in later steps.

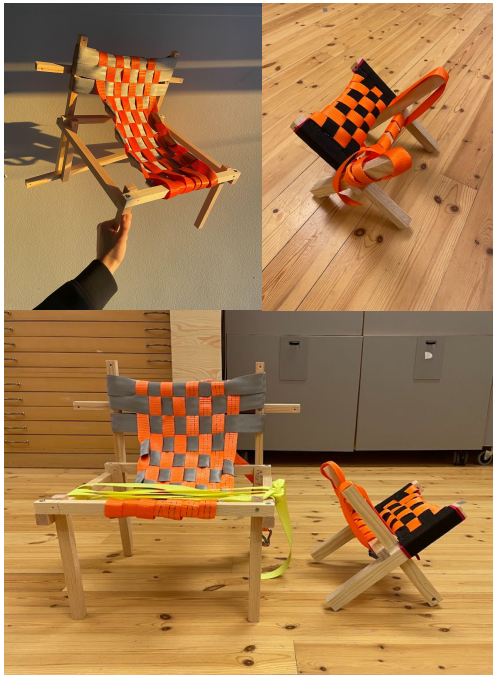
3. Design Process

3.4 Material study

We looked for standard materials that emphasize performance, and tried to create an aesthetic around them.

3. Design Process

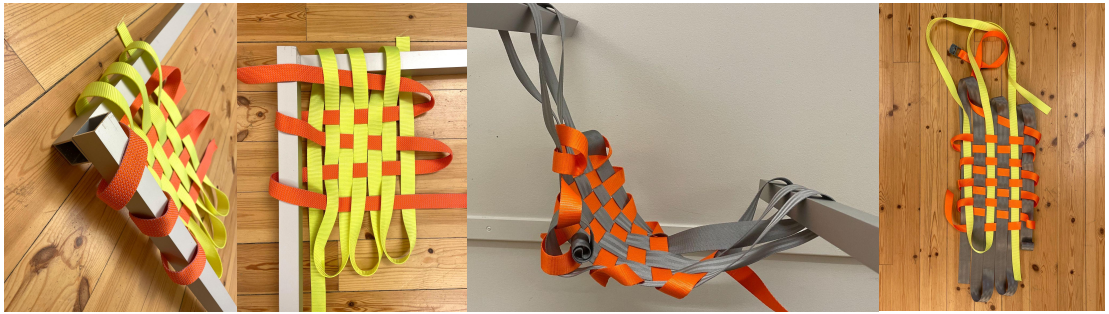
3.5 Structural test: seat



We first decided to use **nylon straps** for the seats. Because compared to canvas, nylon straps offer a more **flexible approach** in terms of both structural and color options.

3. Design Process

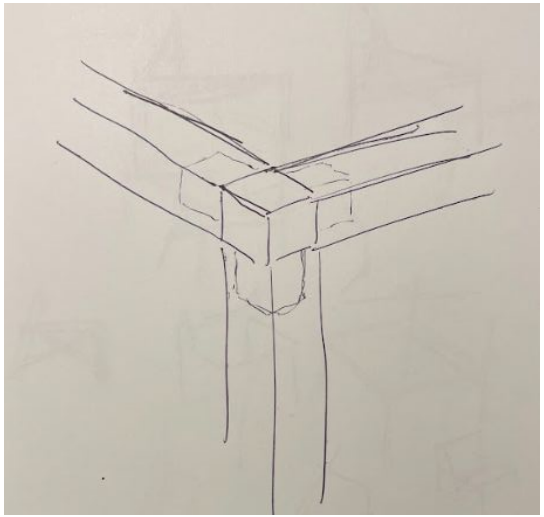
3.5 Structural test: seat

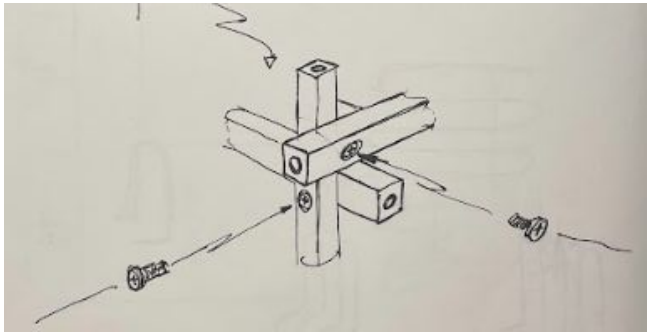


However, the **problem remained**: the same as canvas, it was difficult to support the wrists. In addition, the **sawing process** is even more **complicated** than with fabric.

3. Design Process

3.6 Structural test: legs





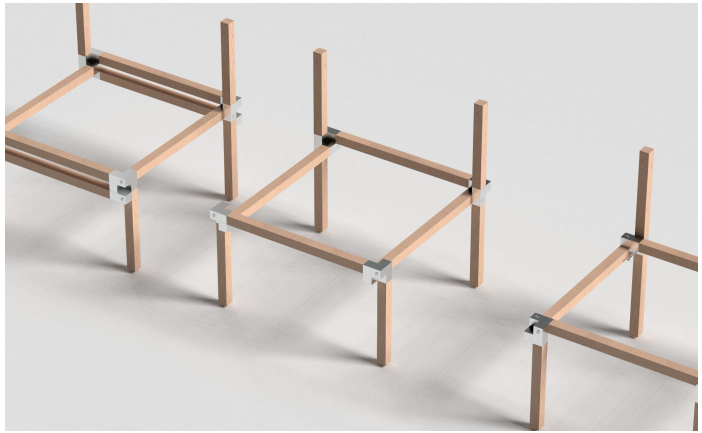
In terms of the **leg**, it should be **light enough** to be transported, and **easily disassembled**. Therefore, the **standard aluminum tube** and its connectors would be a good choice.

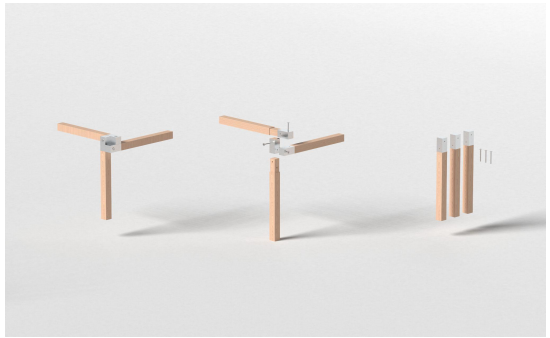
The idea seemed to be feasible until we inserted the connectors into the square tube: they were joined so perfectly that we couldn't even take it out with a **hammer**.

We then decided to find a new way to connect them again.

3. Design Process

3.6 Structural test: legs



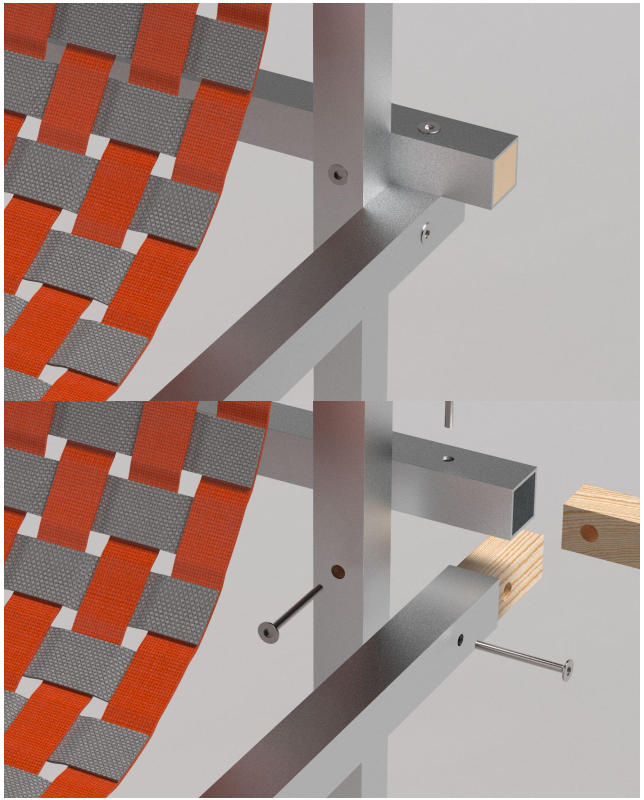


Our subsequent solution for the connector was to make a special **easy-to-disassemble connector** for the tubes.

However, if we kept the same structure, the connector would be shaped differently. This **contradicted** our easy-to-produce concept.

3. Design Process

3.6 Structural test: legs



We tried to keep the previous structure. Since we used the square tubes, if the three tubes were screwed to each other, they could **limit each other's twisting and moving**.

We were not sure whether the structure was strong enough before we tested with aluminum tubes. Therefore, we considered **inserting wooden sticks** to strengthen the connection.

3. Design Process

3.6 Structural test: legs

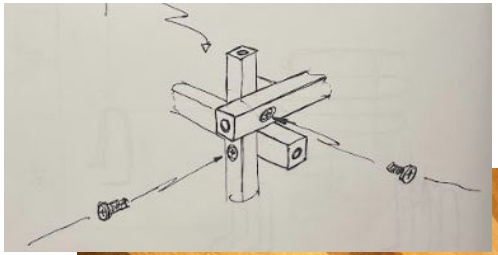
We tested this "three-tubes" structure with both pine and aluminum. We found that the **pine** wood was **too soft** to resist the pressure. After several pressure tests, the joints came loose.

In the case of **aluminum**, it was stronger than we expected. Since wood will not be stronger than aluminum, there is no need to insert wood. Also, the holes should be drilled in a very **precise position**, otherwise the connection may fail.

3. Design Process

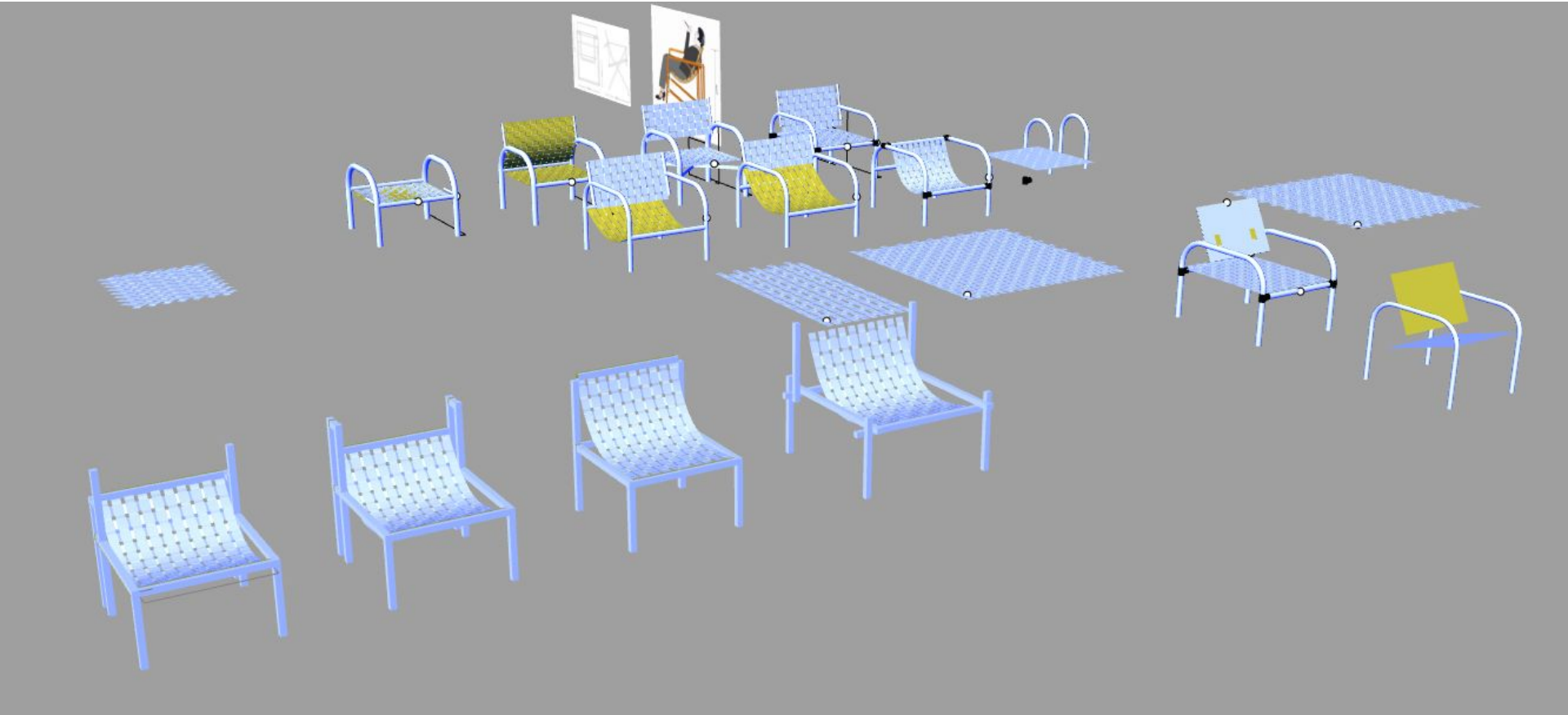
3.7 3D variations: chair #1

After deciding on the joining method we wanted to use, we made 3D variations in Rhino. We tried to find an easier way to make a one-piece seat for the nylon straps.



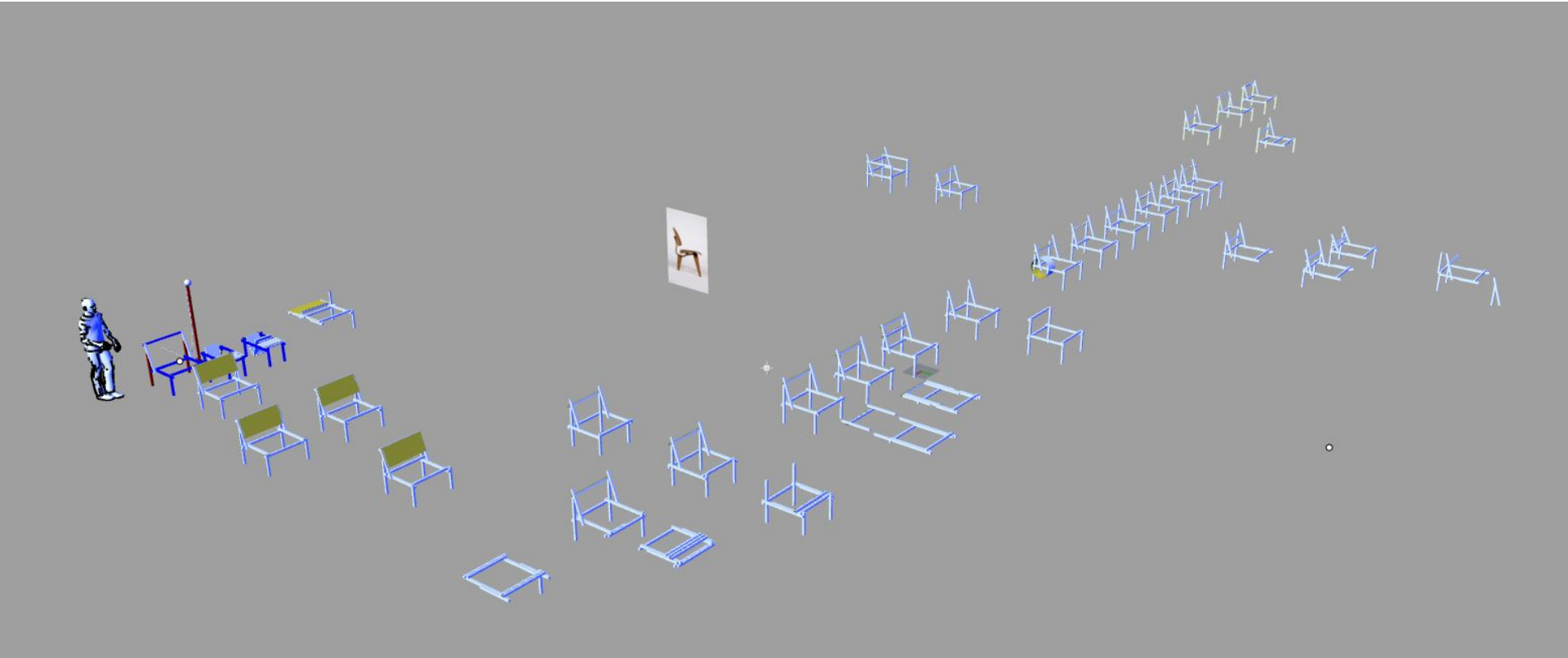
3. Design Process

3.7 3D variations: chair #1



3. Design Process

3.7 3D variations: chair #1



3. Design Process

3.7 3D variations: chair #2

We made the prototype in the meanwhile.

At first, we thought all the tubes should be disassembled when packing. However, we found that it would be too complicated for the user to put them together the first time.

3. Design Process

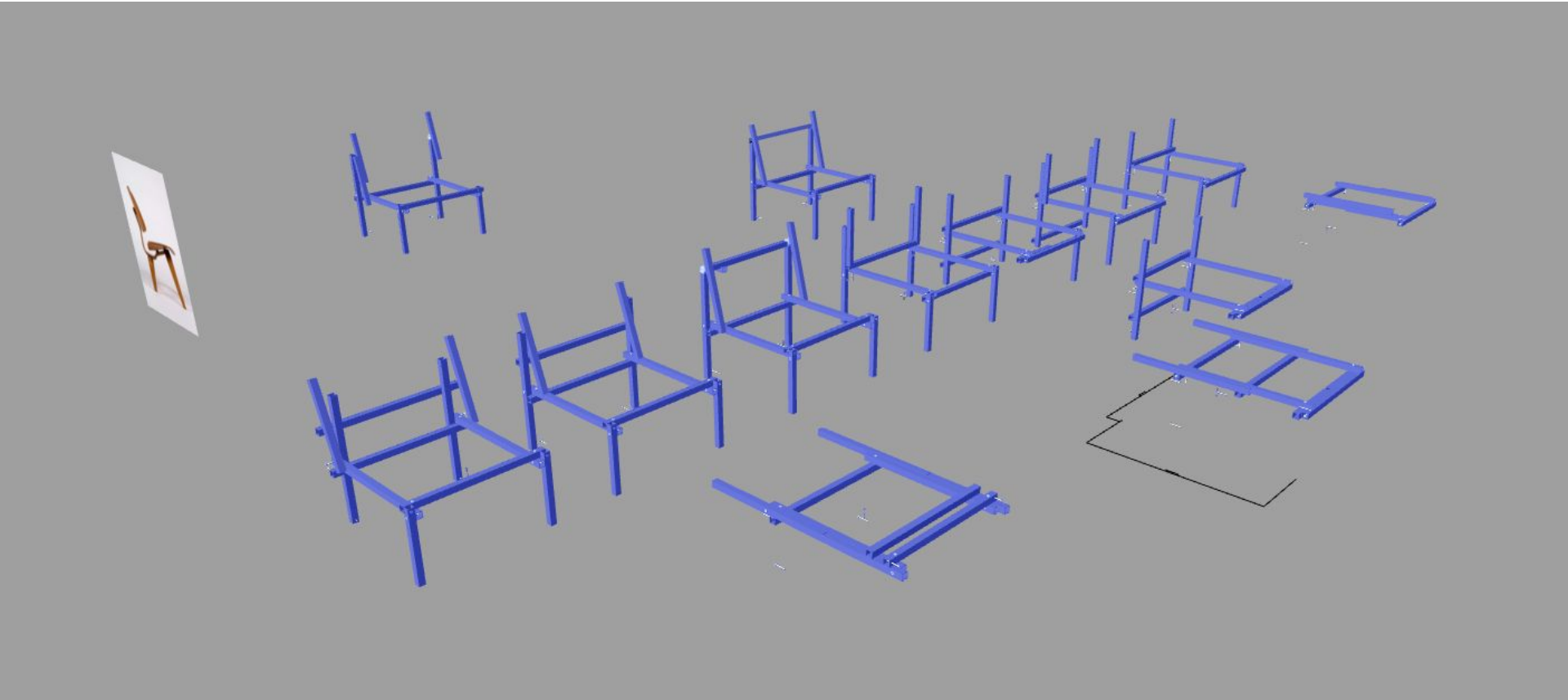
3.7 3D variations: chair #2

When disassembling the legs, we found that if we removed just one screw from the "three tubes" they could be easily rotated to be almost flat. If we have the correct length, they should be completely "flat".

Therefore, we continued modifying the structure to make them easily assembled and flat-packed.

3. Design Process

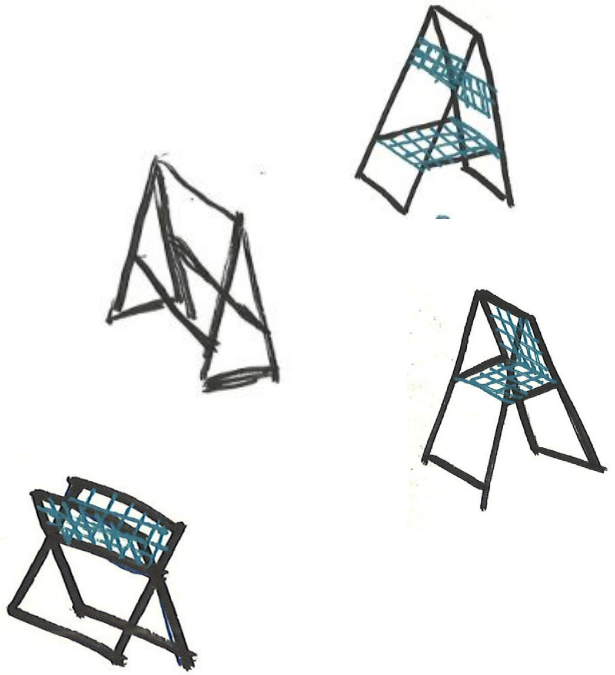
3.7 3D variations: chair #2



3. Design Process

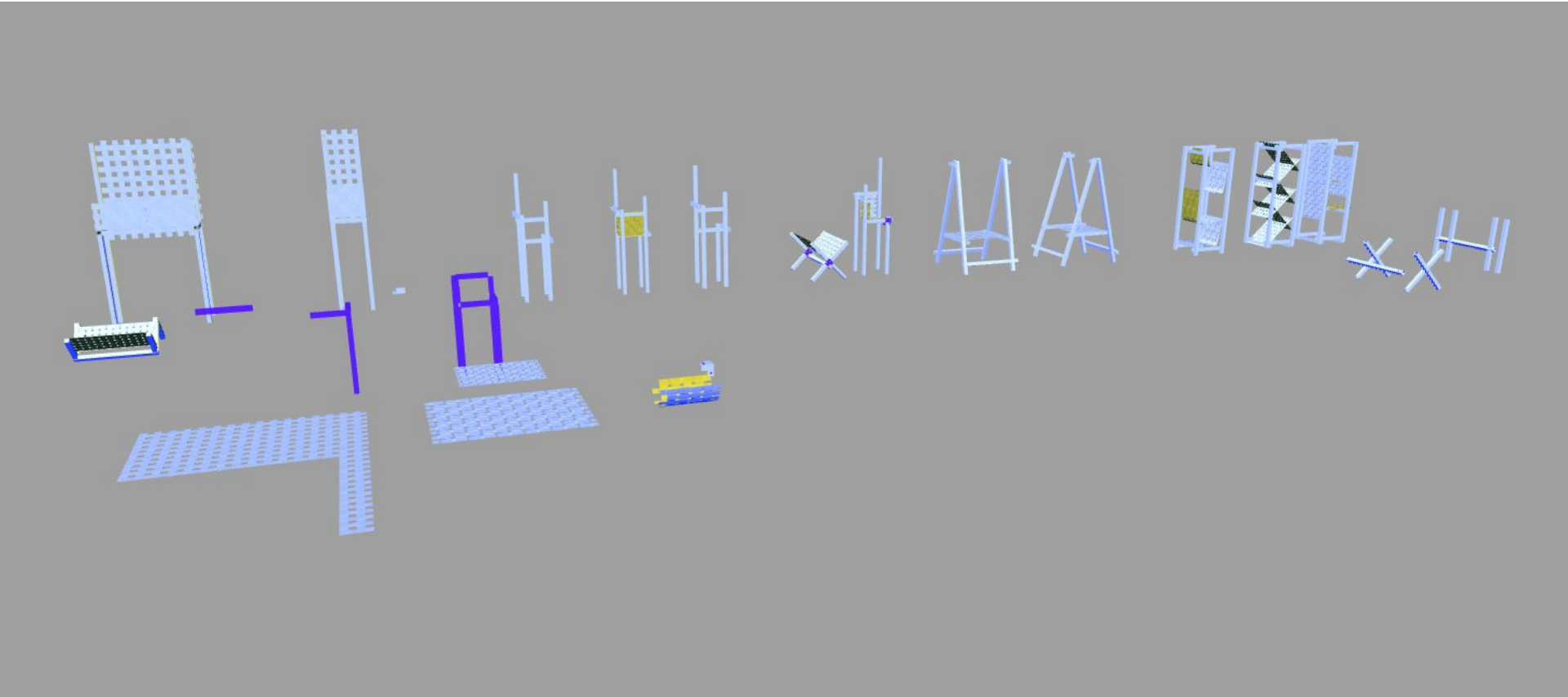
3.8 3D variations: shelf #1

For the shelf, we wanted to continue using the same connection method and try more variations. Therefore, we started using a "V" shape instead of a right angle.



3. Design Process

3.8 3D variations: shelf #1



3. Design Process

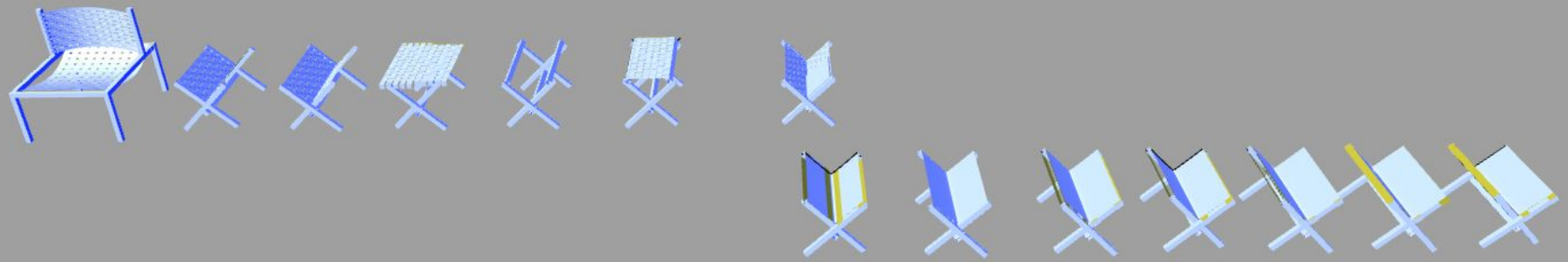
3.8 3D variations: shelf #2

After testing with wooden sticks, we realized that the "three tubes" should be at right angles to each other to maintain a stable structure.

We came up with two solutions: either make the shelf "X" or "H" shape.

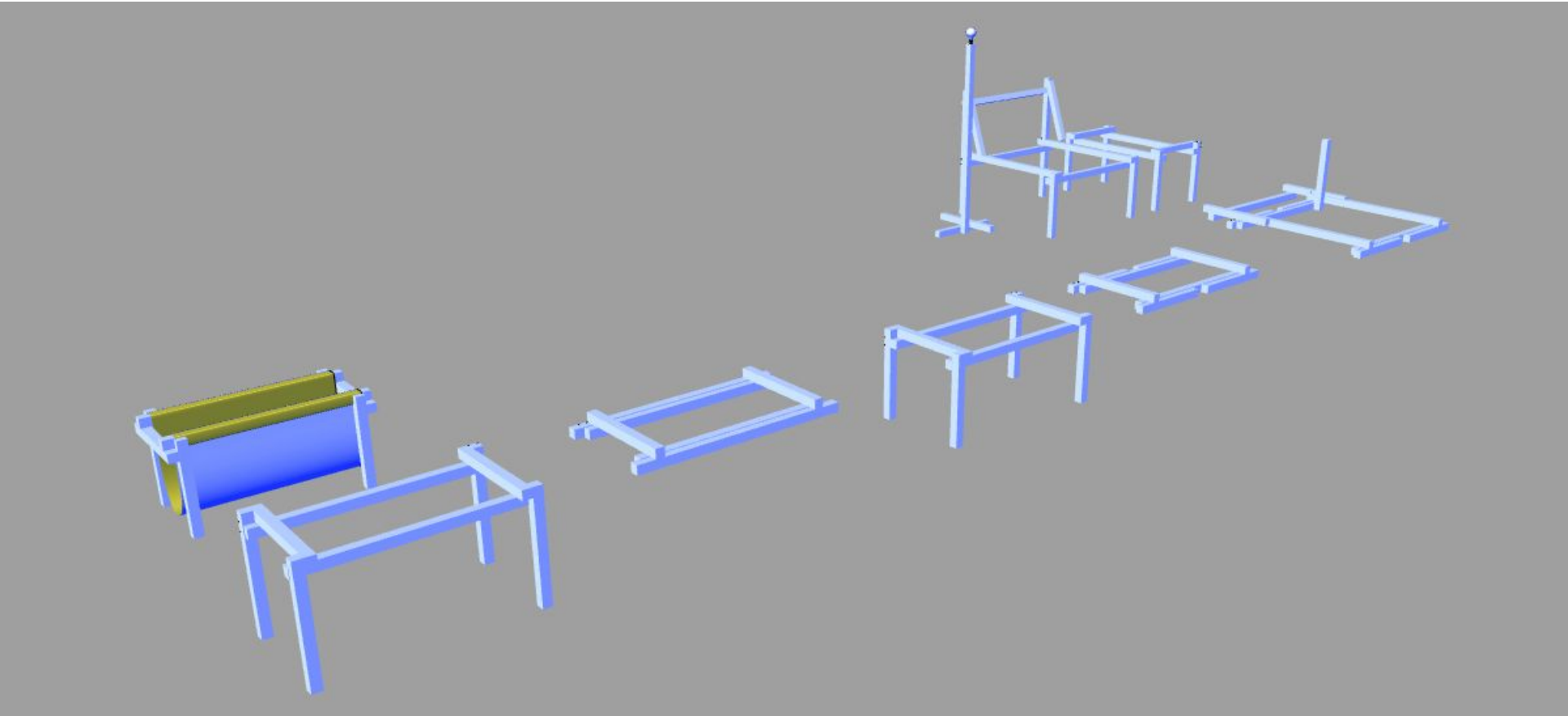
3. Design Process

3.8 3D variations: shelf #2



3. Design Process

3.8 3D variations: shelf #2



3. Design Process

3.8 3D variations: shelf #2

The problems with the "X" shape are:

1, only half of the space is available for placing items, which is a waste of material and contradicts our brief;

2, if we don't insert an extra foot pad, the legs are at a 45-degree angle to the floor, which will scratch the floor easily.

As a result, we voted for the “H” shaped shelf.

“X” shape

“H” shape

3. Design Process

3.9 Sturctural test 2

One-piece seat

We first tested this one-piece structure according to our 3D model. But the problem was the same as the canvas: due to the lack of support on both sides, the nylon seat tended to sink, causing the crossbeam to hurt the legs.

3. Design Process

3.9 Sturctural test 2

Further support

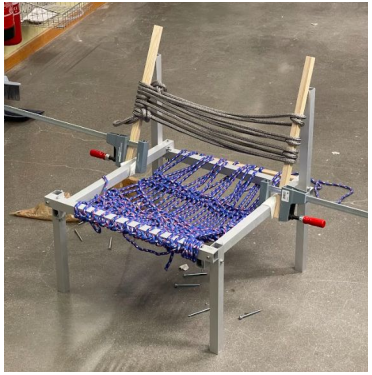
We then used nylon straps hanging through from left to right side. The problem of leg-pressure was reduced. So we decided to hang from left to right for better comfort.

3. Design Process

3.9 Sturctural test 2

Two-piece structure

If the seat was divided into two parts, the seat backrest could not support the wrists at this vertical angle. An additional reclined seat backrest was required.

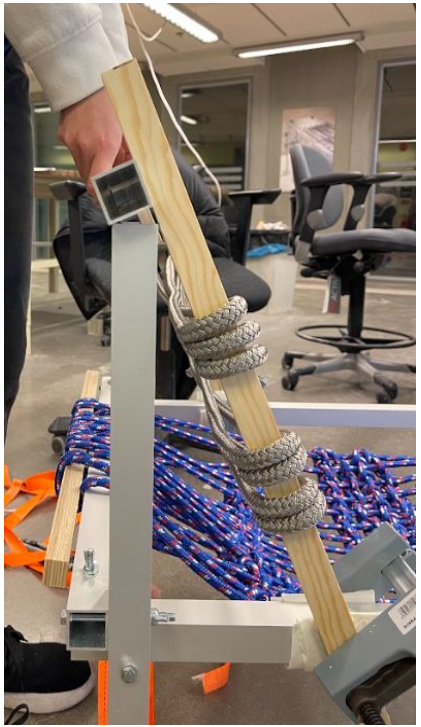


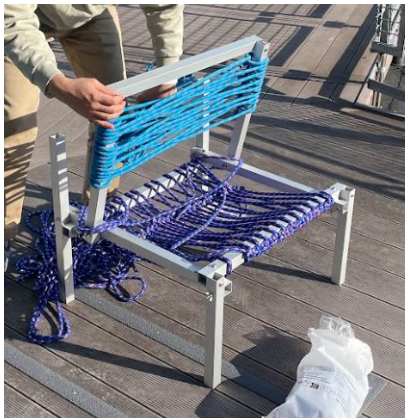
3. Design Process

3.9 Sturctural test 2

Reclined seatback

We analyzed the existing chairs and tried different angels.





3. Design Process

3.9 Sturctural test 2

From nylon straps to ropes

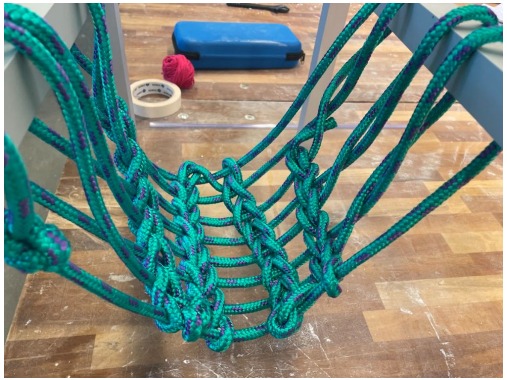
Meanwhile, we figured out that the rope was better than the strap. The reason was that we didn't need to do the complicated sewing process. We could simply tie a knot to make the rope stable.

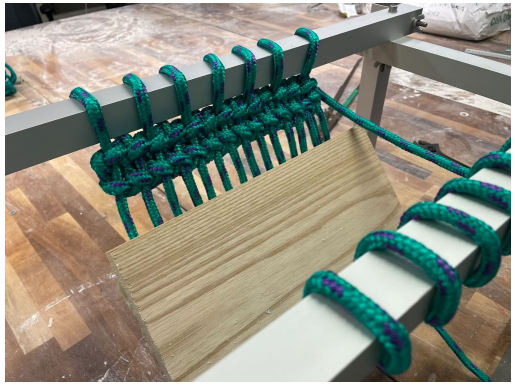
3. Design Process

3.9 Sturctural test 2

Weaving Method

Since the magazine holder needed to hang loosely, we applied the weaving method to make sure it stays fixed.





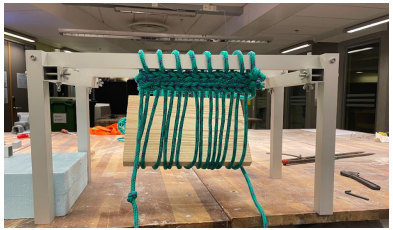
3. Design Process

3.9 Sturctural test 2

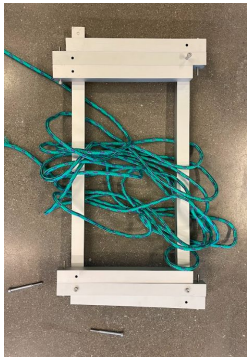
Folding process

First, we hung the rope on the long side. But we realized that the four legs could not be folded flat, because the rope would stop the legs from folding. We then decided hanging rope on the short side.

hang on the long side



hang on the short side



3. Design Process

3.9 Sturctural test 2

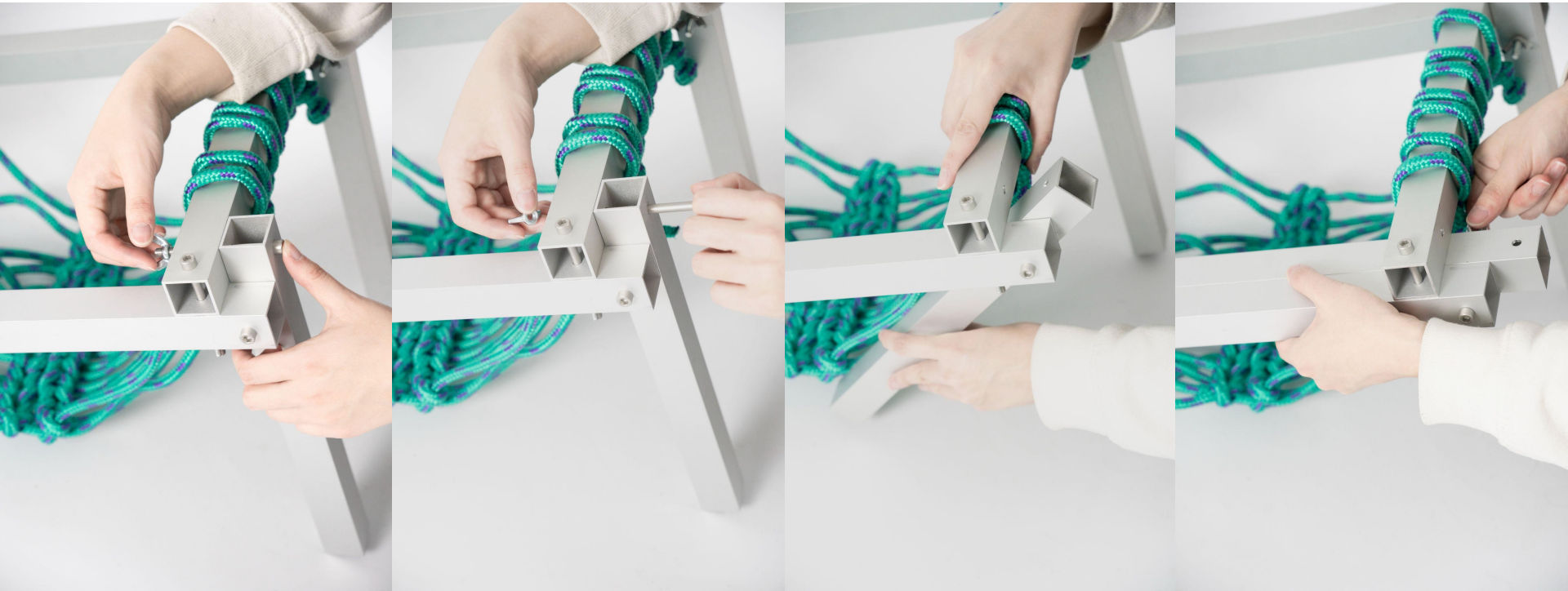
A side table with magazine holder

If we simply hang the rope from the short side, the magazine holder becomes too long. Also, a side table would be more useful than a magazine shelf. So we decided to add a tabletop plane with rope to the shelf.

3. Design Process

3.9 Sturctural test 2

Fold the three tubes by removing one screw.



3. Design Process

3.10 Edge finishing

We took into consideration that since we left the tube without a cap, it would be easy to scratch the skin. Therefore, as a prototype, we sandblasted the edges of the tubes to make sure it was smooth. This aims at simulating the anodizing process of aluminum.

3. Design Process

3.11 Packability test

We recorded the time for packaging and assembly. The process took about 2 minutes for each item.

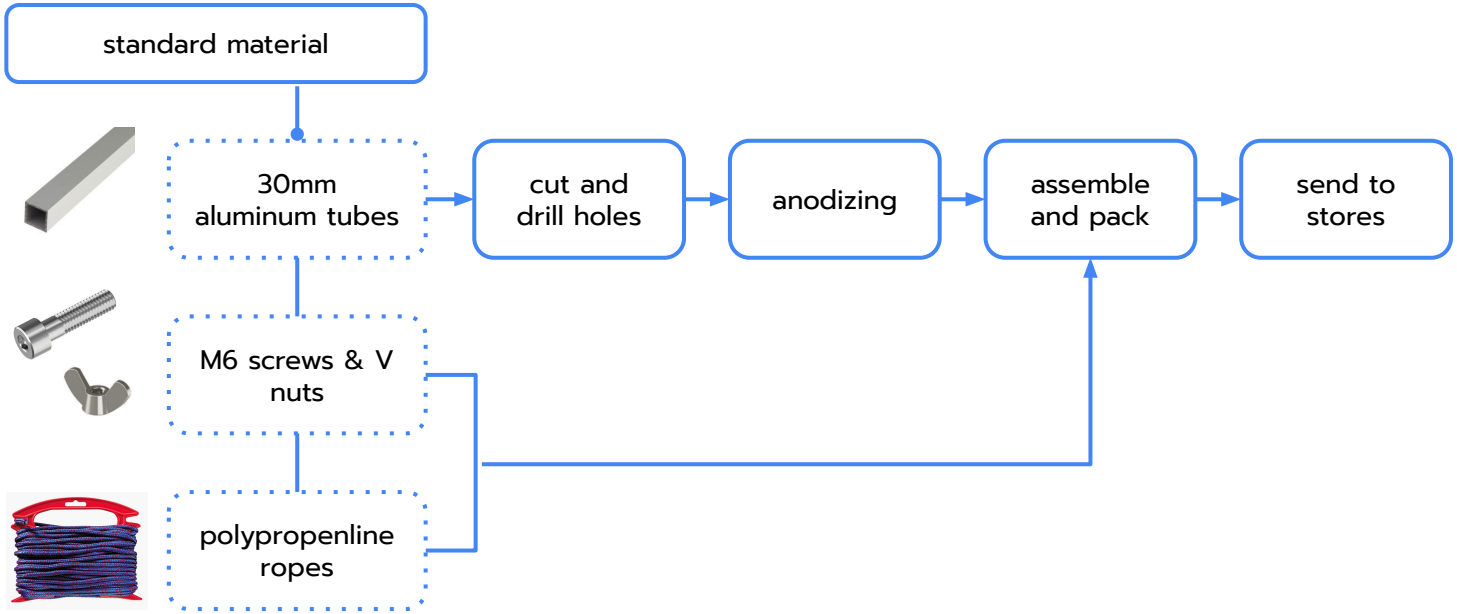
4. Final Design

4.1 Concept

A furniture collection designed to maximize flexible production and usage, for times of chaos.

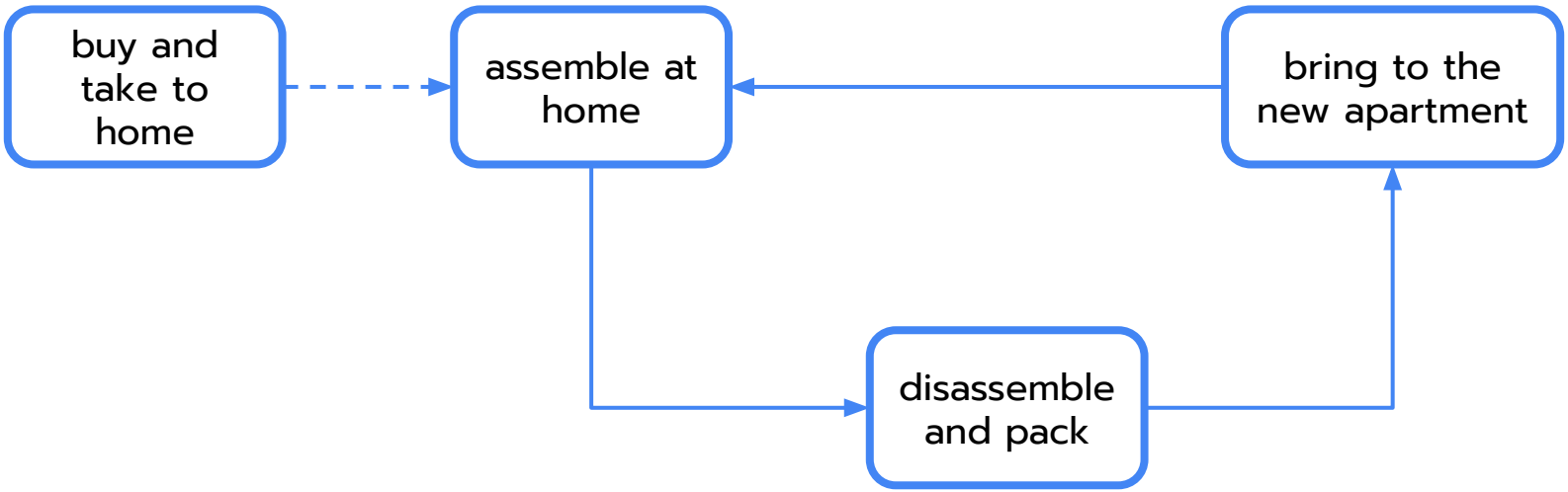
4. Final Design

4.2 Production process



4. Final Design

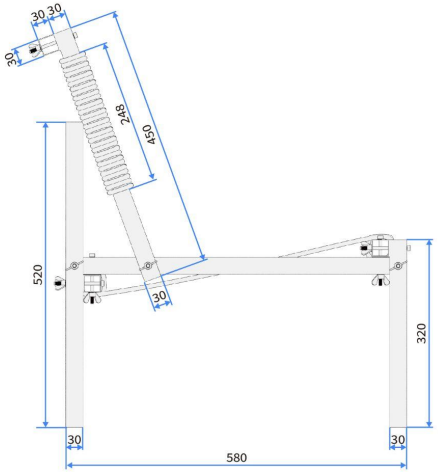
4.3 Usage map

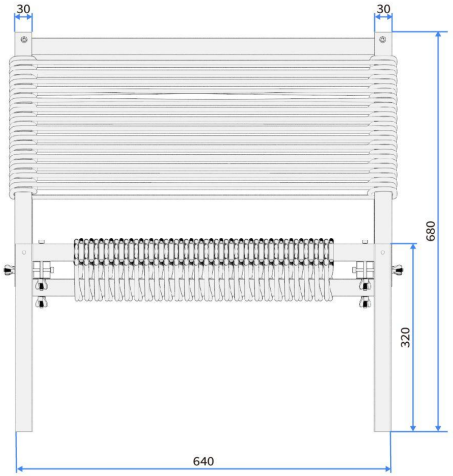


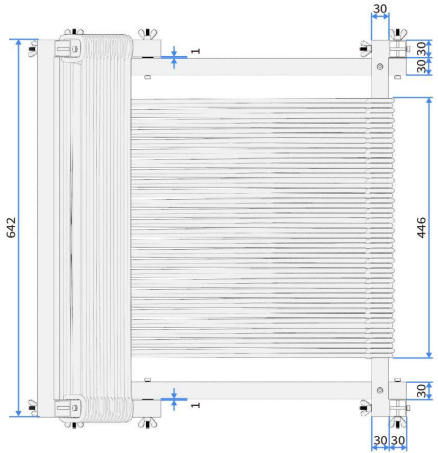
4. Final Design

4.4 Technical drawing

Lounge Chair







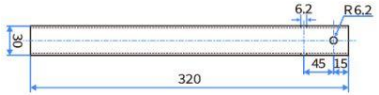
Dimensions
Unit: mm

4. Final Design

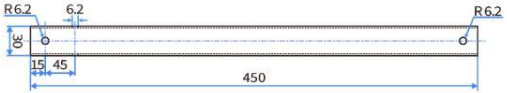
4.4 Technical drawing

Lounge Chair

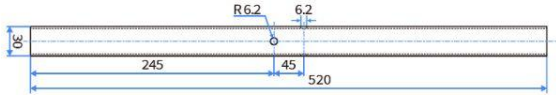
30*30*2 Aluminum Profile



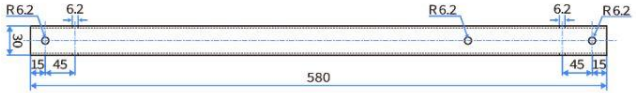
X 2



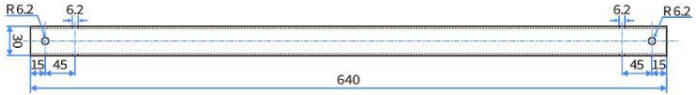
X 2



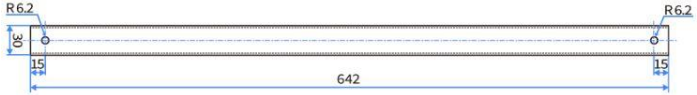
X 2



X 2



X 2



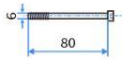
X 1

Polypropylene Rope

X 1

X 1

M6 Shoulder Screw



X 16

M6 Wing Nut

X 16

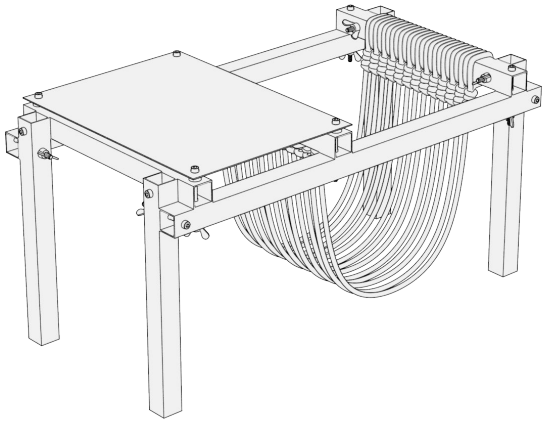
1mm Washer

X 2

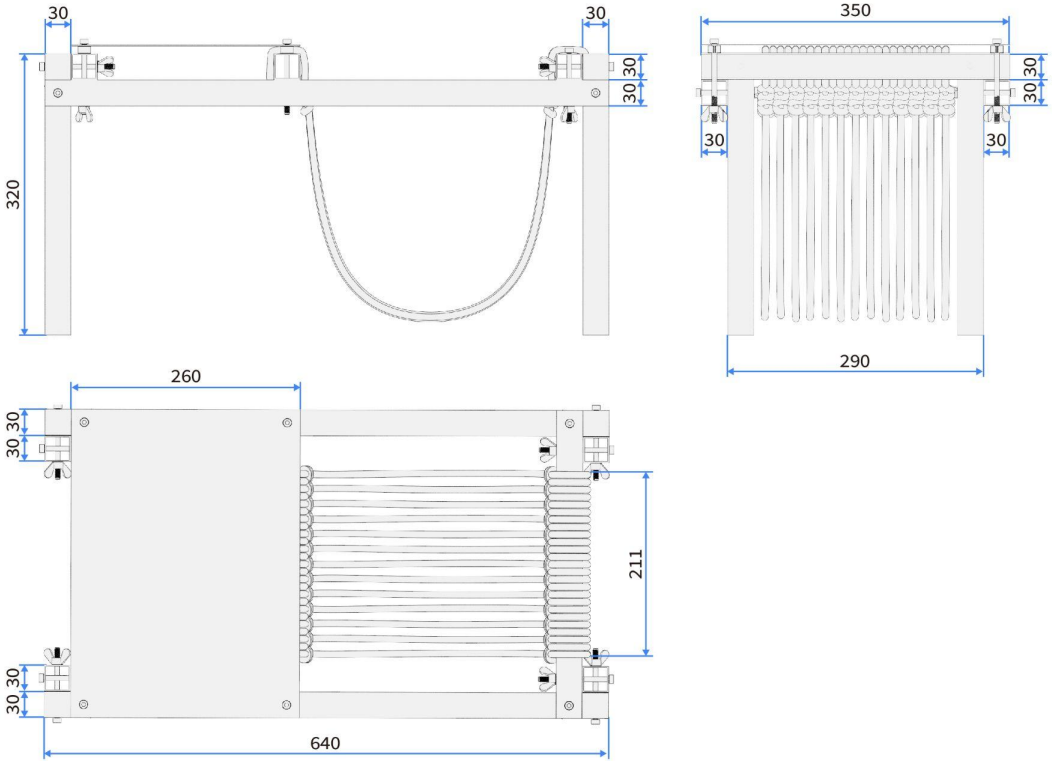
Dimensions
Unit: mm

4. Final Design

4.4 Technical drawing



Side Table



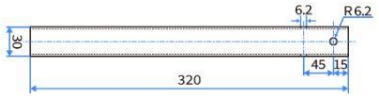
Dimensions
Unit: mm

4. Final Design

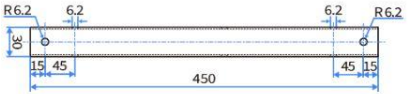
4.4 Technical drawing

Side Table

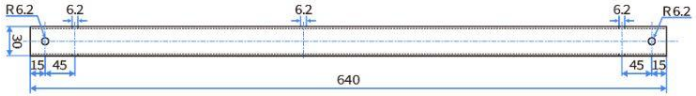
30*30*2 Aluminum Profile



X 4

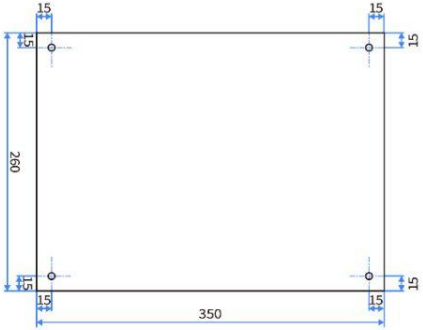


X 3



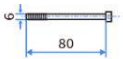
X 2

3mm Aluminium Sheet



X 1

M6 Shoulder Screw



X 14

M6 Wing Nut

X 14

Polypropylene Rope

X 3

8mm Washer

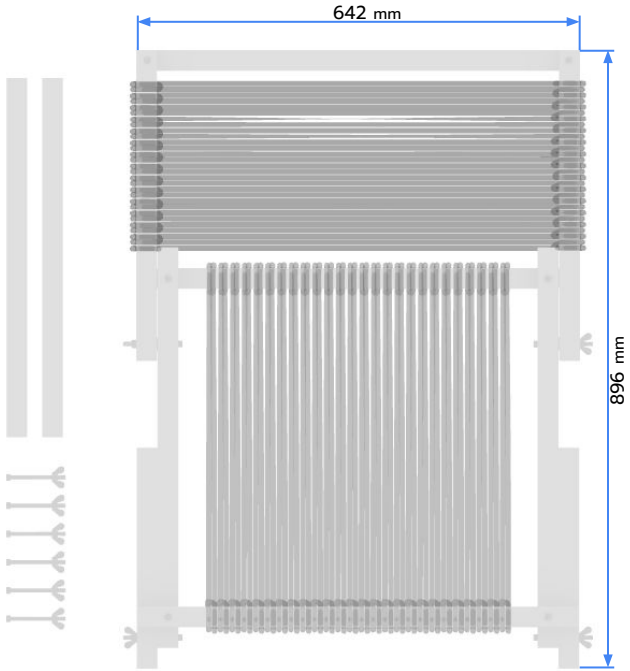
X 4

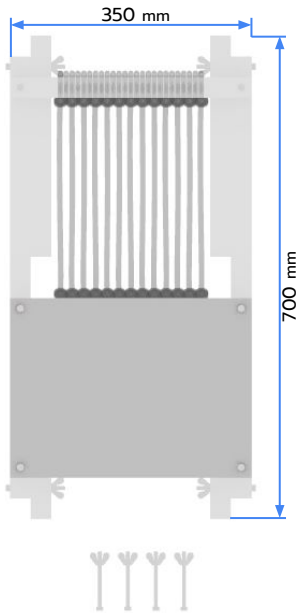
Dimensions
Unit: mm

4. Final Design

4.4 Technical drawing

Folded size





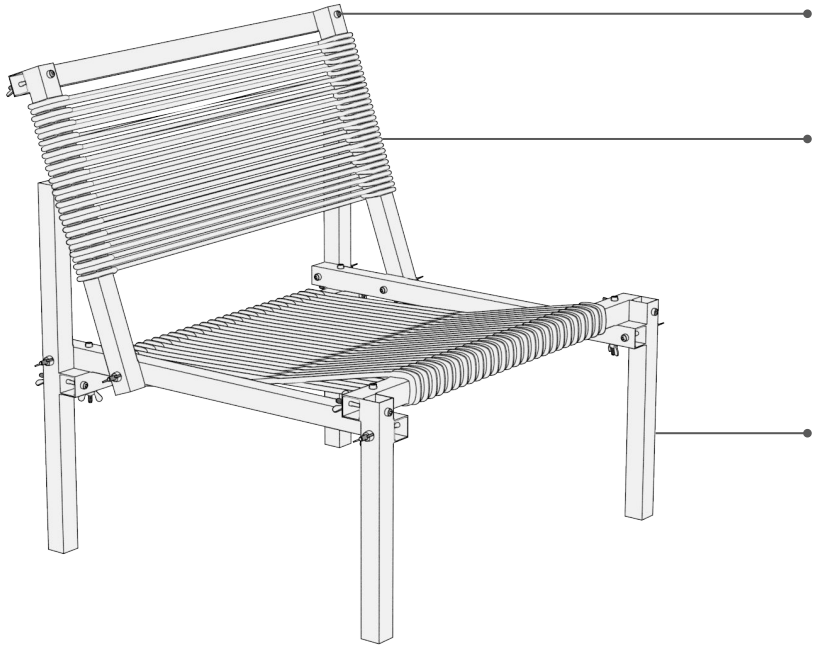
Dimensions
Unit: mm

Lounge chair

Side table

4. Final Design

4.5 CMF specification



M6 Shoulder Bolt/ Screw
Sand-blasted

Polypropylene Rope

Aluminum Profile
30mm*30mm*2mm
Anodized

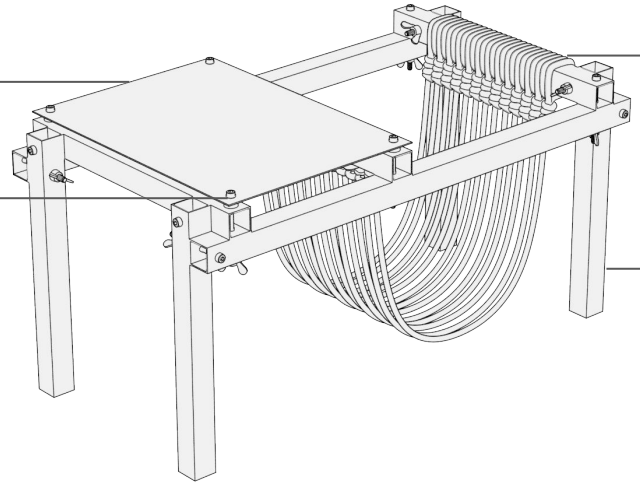
Lounge Chair

4. Final Design

4.5 CMF specification

Aluminum Sheet 3mm
Sand-blasted

M6 Shoulder Bolt/ Screw
Sand-blasted



Polypropylene Rope

Aluminum Profile
30mm*30mm*2mm
Anodized

Side Table

4. Final Design

4.6 Prototypes

4. Final Design

4.6 Prototypes


1


2


3

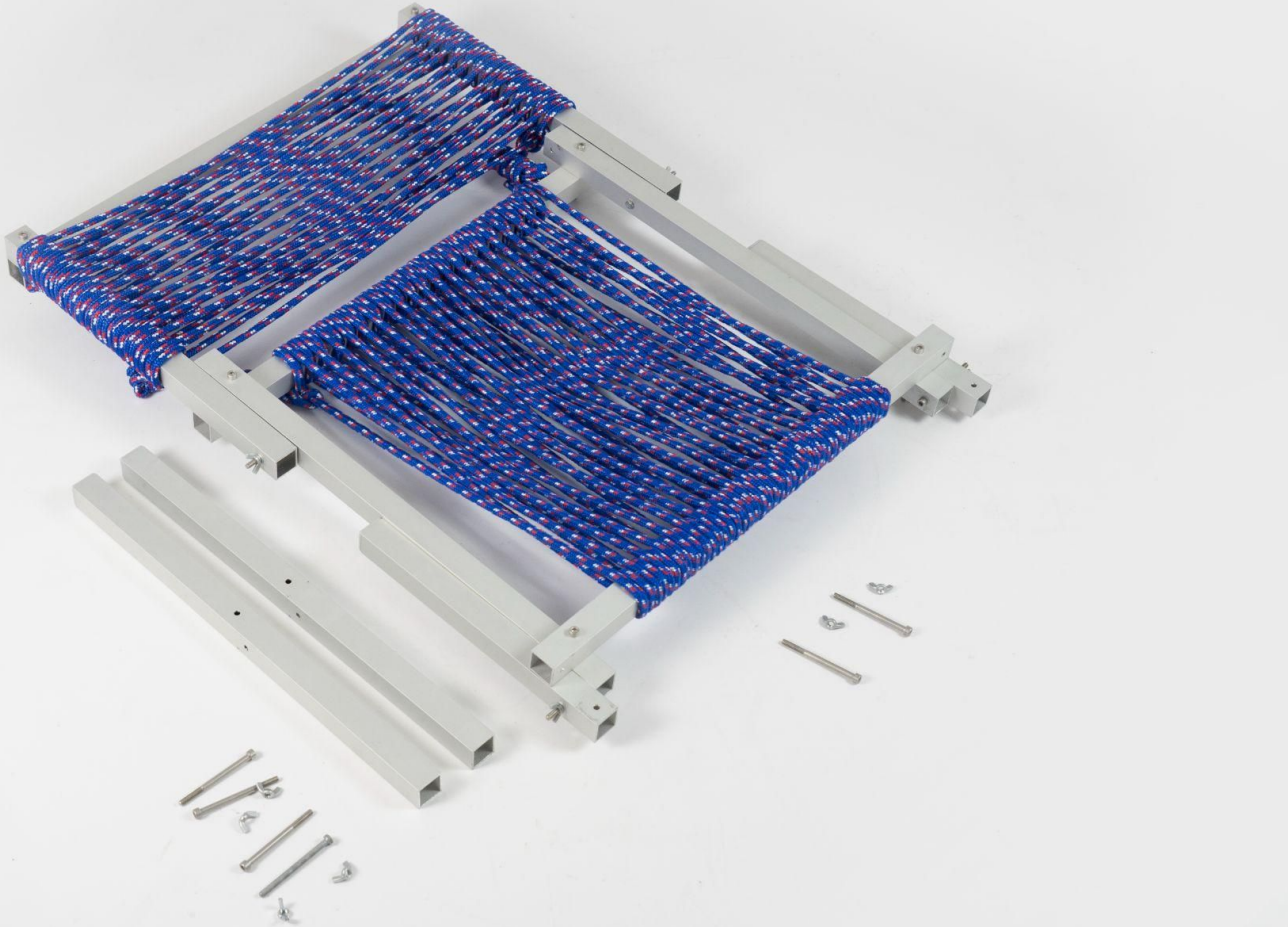

4


5


6

4. Final Design

4.6 Prototypes

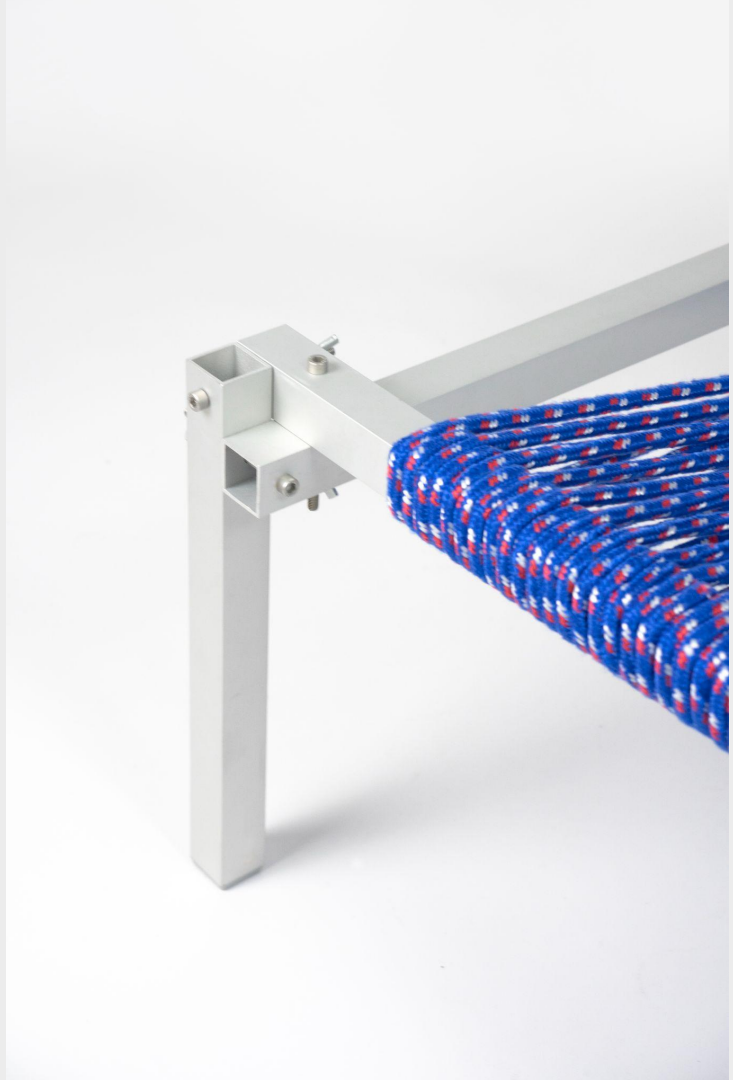


4. Final Design

4.6 Prototypes

4. Final Design

4.6 Prototypes



4. Final Design

4.6 Prototypes

4. Final Design

4.6 Prototypes

1

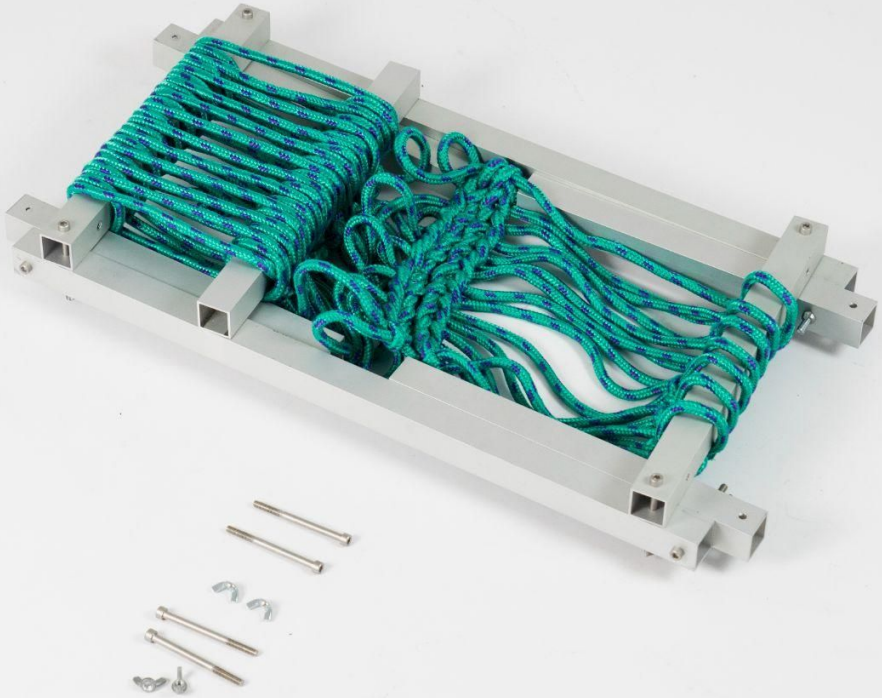
2

3

4

4. Final Design

4.6 Prototypes



4. Final Design

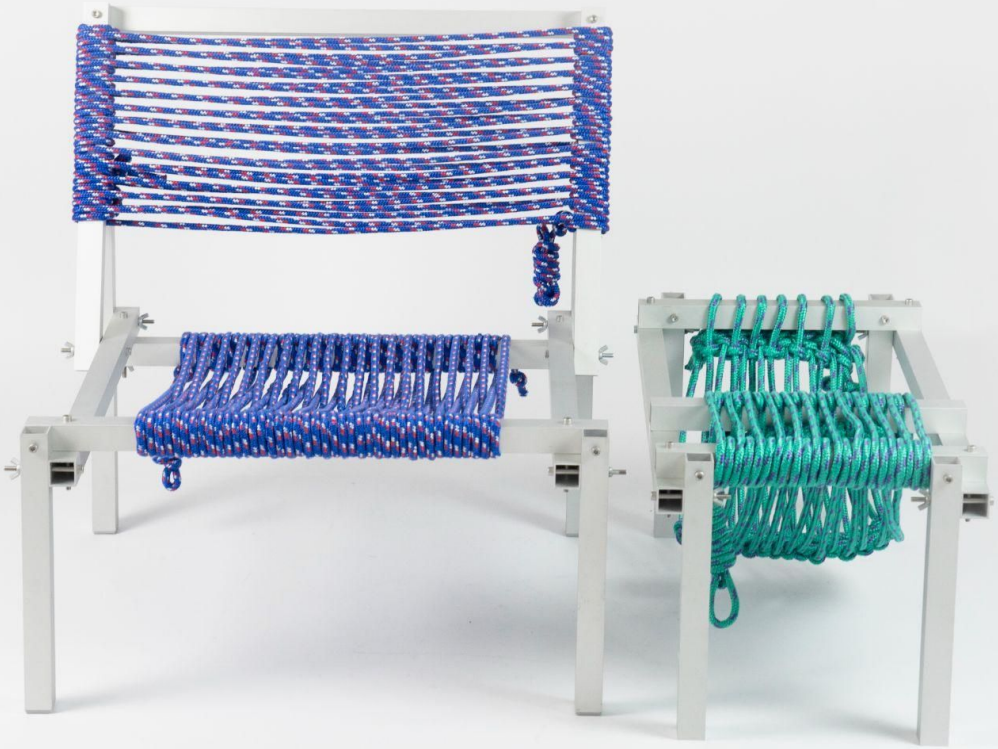
4.6 Prototypes

4. Final Design

4.6 Prototypes

4. Final Design

4.6 Prototypes



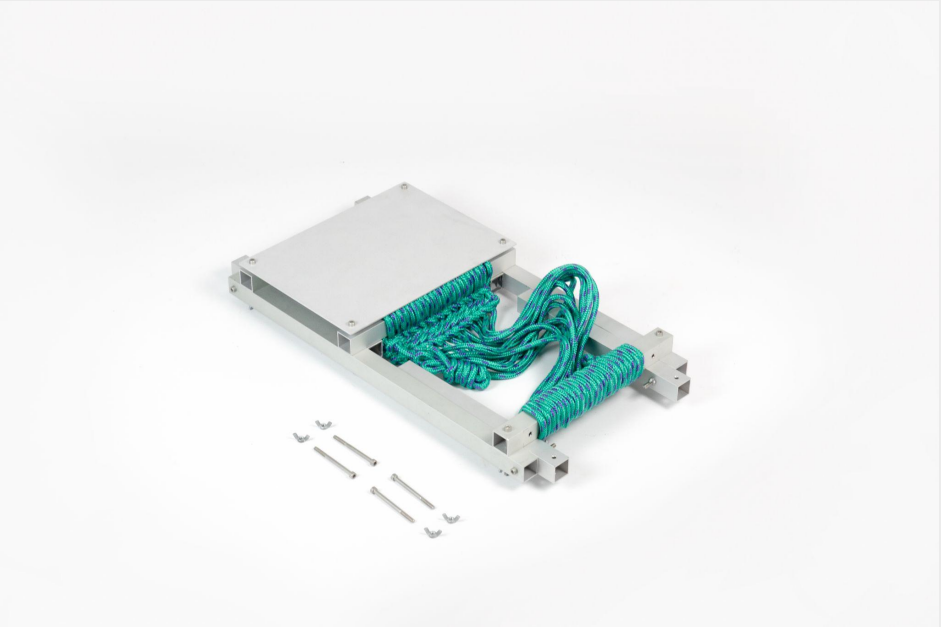
4. Final Design

4.6 Prototypes

4. Final Design

4.6 Prototypes

Since the rope plane was not flat enough to hold the cups, we switched to an aluminum plane for the side table.



4. Final Design

4.7 Further development

4. Final Design

4.8 Exhibition

4. Final Design

4.8 Exhibition

4. Final Design

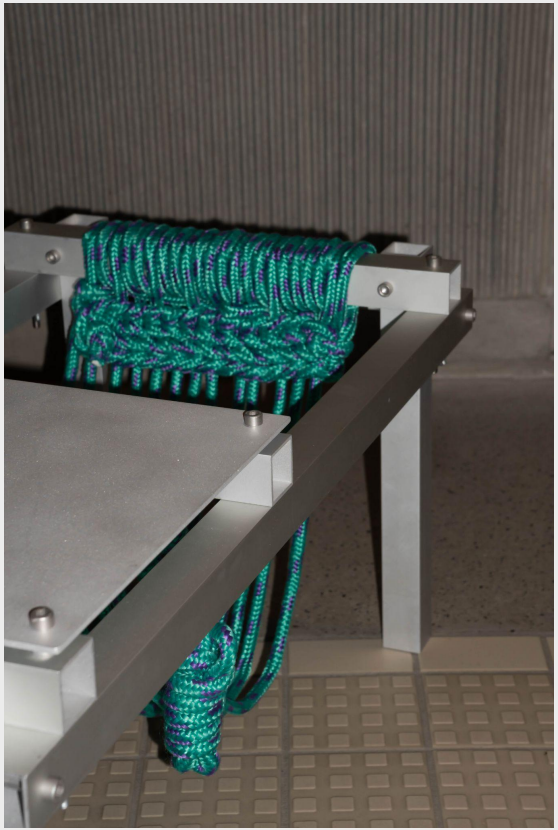
4.9 Scenario

4. Final Design

4.9 Scenario

4. Final Design

4.9 Scenario

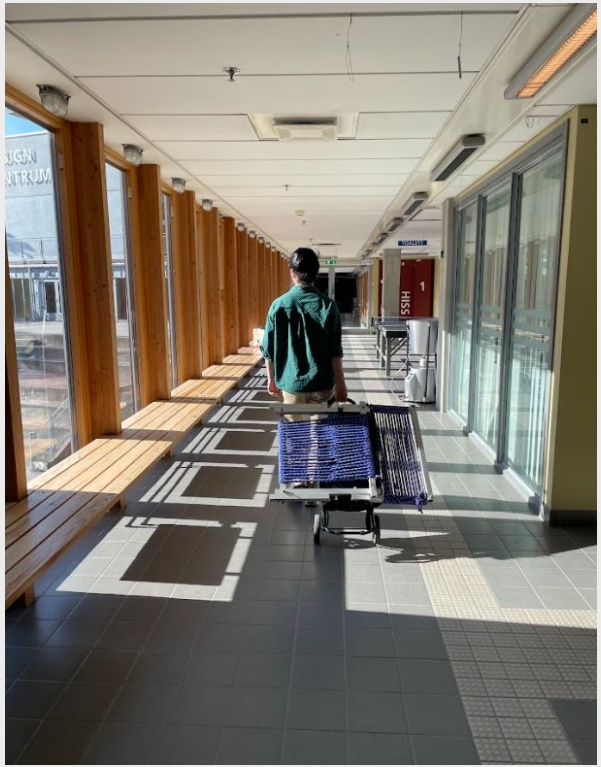


4. Final Design

4.9 Scenario

4. Final Design

4.9 Scenario



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[Vitra - Lounge Chair] n.d. [image online] Available at: <https://www.connox.com/categories/furniture/lounge-chairs/vitra-lounge-chair-cherry-wood.html?itm=178958&p=103947&Action=Change&CurrencyCode=EUR>
Bergheim, M. B., n.d. 3 rod connection [image online] Available at: <https://aromablind.myportfolio.com/wardrobe>
Kommer, S., 2021. PUR_PA_02. [image online] Available at: <https://sebastiankommer.com/PUR_PA_02>