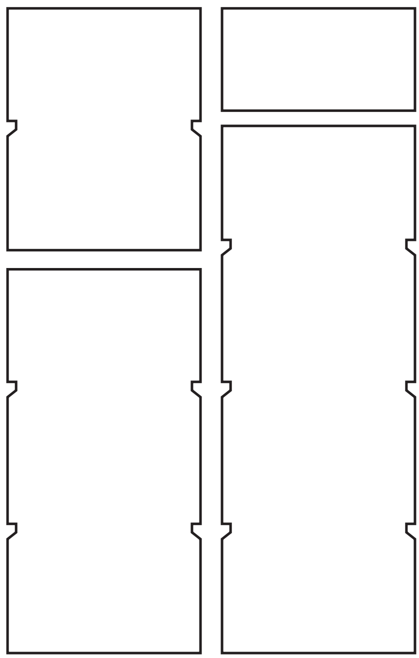
Dessau Department of Design
Anhalt University of Applied Sciences
Short Project
October 5 to 16, 2020

The Aesthetics



# of Efficiency

in collaboration with

MATERIABILITY

ERNST

16 BOXES

The Aesthetics of Efficiency

The Aesthetics of Efficiency

Material & Technology
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Introduction

In a world, where we're becoming ever more aware of limited and declining resources, and where current production processes and individual lifestyles are far beyond the threshold of subsistence, a new challenge arises to the designer/architect: To create products and buildings, which a priori propose a solution to overconsumption and overproduction. Products, which ideally both instigate an alternative to the status quo and which challenge current processes towards a more sustainable future.

The Berlin based firm **16boxes** took this challenge seriously and designed the 16boxes System Shelf, which uses 67% to 75% less material than comparable products on the market. After being among the selected designs for the **Green Product Award 2020** and nominated for **Deutscher Nachhaltigkeitspreis 2021**, the company now wants to go even further.

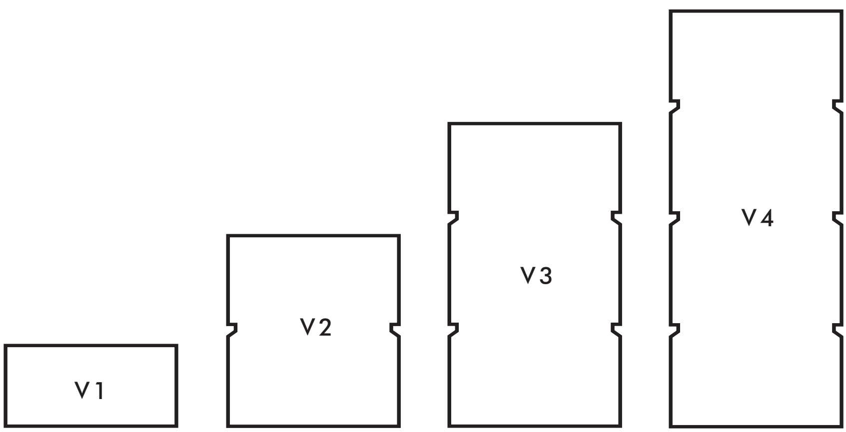
While everything about the design of the 16boxes System Shelf focuses on sustainability and efficiency the firm still struggles in solving one particular point of wastefulness: during production, there is an overproportion of plywood cut-outs, which cannot be used for other parts.

The Challenge

The aim of the short project **The Aesthetics of Efficiency** from October 5 to 16, 2020 was to develop useful products with maximum material efficiency and functionality from the aforementioned cut-outs.

The challenge was not only to design and prototype useful products that could be manufactured on the existing **16boxes** production line, but also to emphasize the novel possibilities arising from digital technologies.

The following pages present the five projects that nine students developed within 12 days.



Residue plywood cut-outs

The Requirements

The final product designs had to meet the following requirements:

- The design needed to be a functional and pluggable object of everyday use, which can be self-assembled by the user in short time.
- The assembly should be playful and enjoyable.
- The wood cut-outs needed to be used and further processed through CNC and/or with other serial wood working machines.
- Further leftover materials from industrial production could be incorporated.
- Mass manufactured supplier parts could be used, IF there was a necessity given in terms of form and function.
- Parts could be 3D-printed or digitally fabricated using adjacent technologies.
- The final design had to be novel and shouldn't already exist on the market.

Slim Bartender

Paul Fischer

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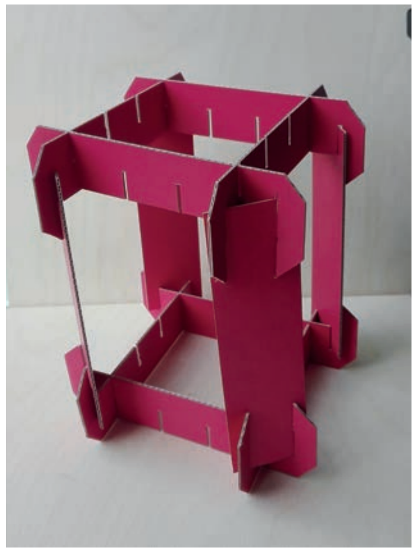
Idea

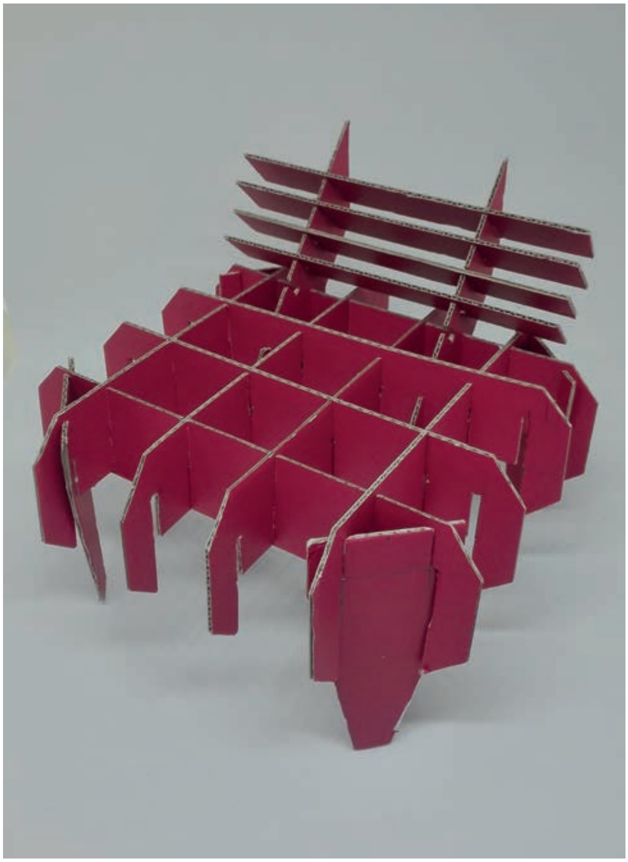
The main criteria of my design were based on the given limitations. I wanted to develop a piece of furniture that is light and stable in its composition. The parts of my product should be milled from the wood waste left over from the **16boxes** shelves. The whole piece of furniture should be assembled exclusively by plug connections and the user should be able to assemble it by himself. The assembly of the parts should be fast, intuitive and fun.

Experiment I



The first experiments served to gain a better understanding of connectors. The goal was to find a stable connection solution that is robust enough to be further developed. The grid connector system proved to be the strongest connection and also created its own design language. The grid can also be expanded in many ways, which makes it easier to add extra parts such as legs or surfaces.

Experiment II



The object received a test application in the form of an armchair. The grid can easily be converted into a seat and the corners by adding two pairs of feet of different lengths. This creates a sloping surface, which improves the seating comfort. The backrest should resemble the grid in order not to break the uniform design. The disadvantage is, however, that the armchair consists of too many different, additive individual parts that are not hidden underneath each other or can fall off.

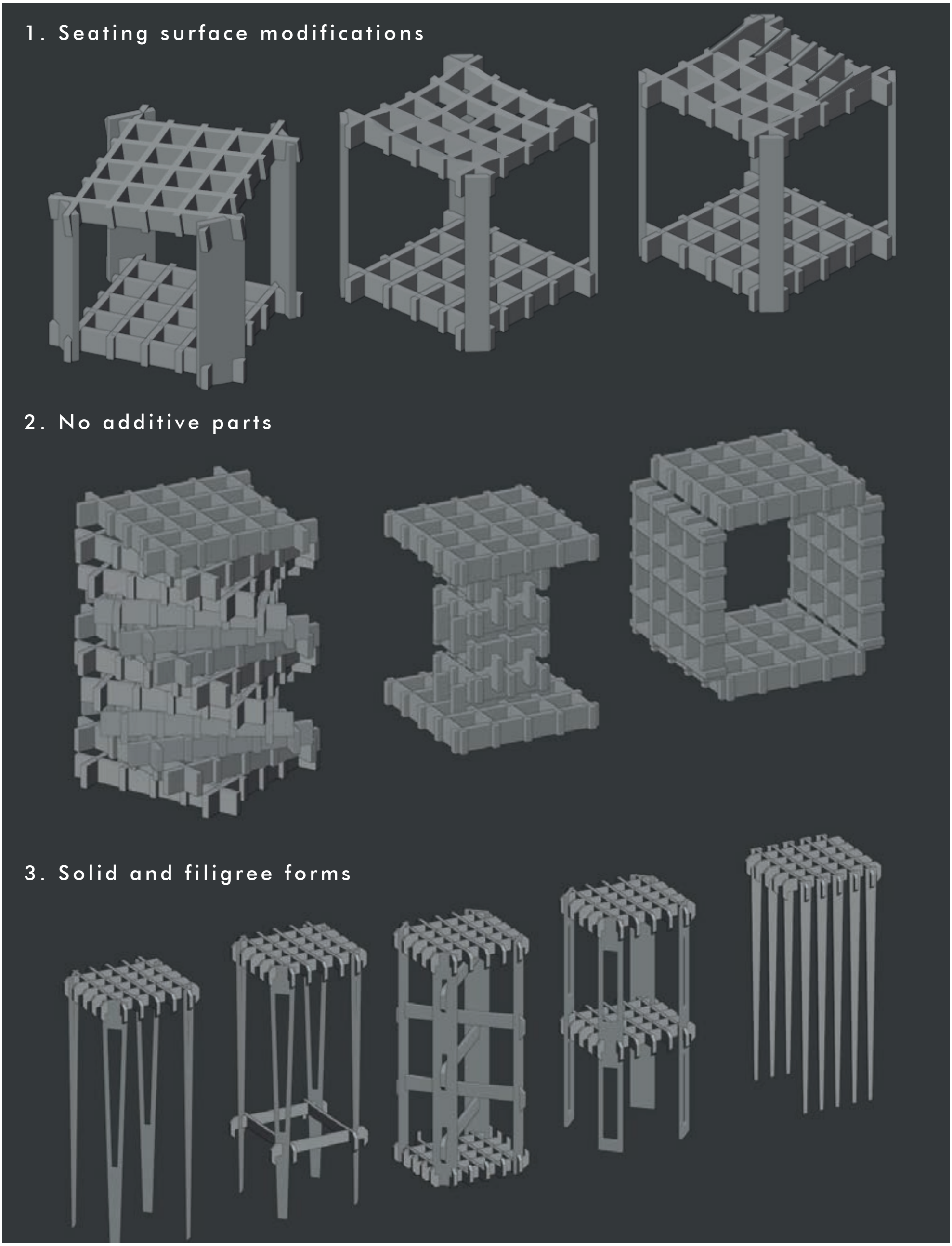
Experiment III

With the help of the 3D modeling software Blender further shape experiments were developed. I focused on a barstool model to achieve product diversity and to distinguish myself from the product ideas of my fellow students.

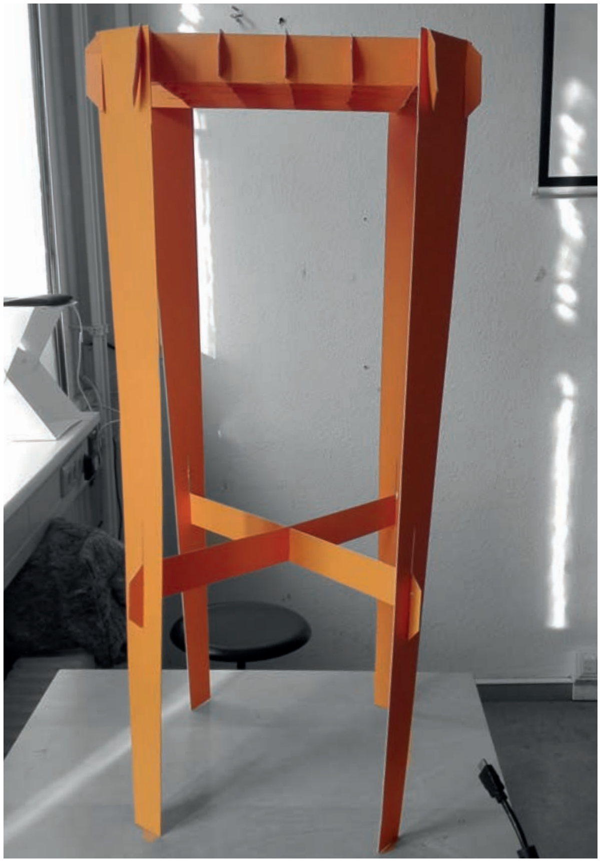
Point 1 concentrated on different shapes of the surfaces (sloping, straight and concave).

The stools in point 2 consist solely of the grid part and do not require any additional parts. I tried to find out if this method can be used to create a uniform overall picture or to gain more stability. But the results were too clumsy and in the end would only make the furniture unnecessarily difficult.

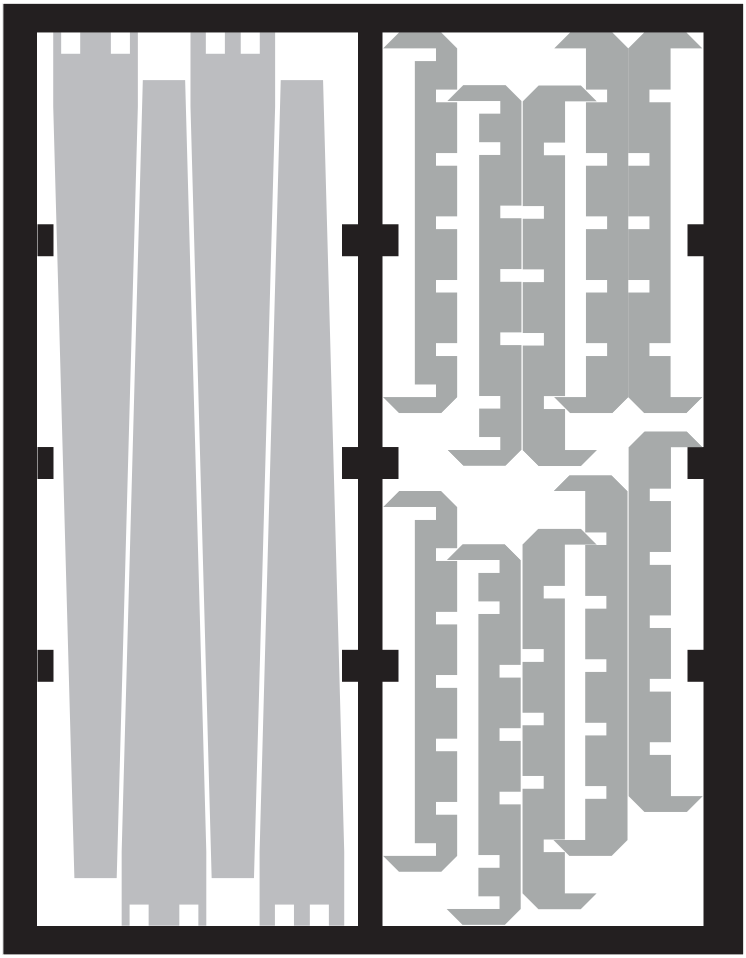
Point 3 plays with fine lines, large boards and stabilization elements that are supposed to support the long legs.

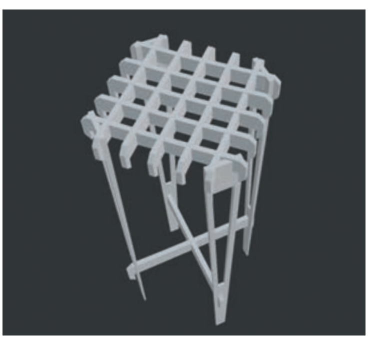

1. Seating surface modifications
2. No additive parts
3. Solid and filigree forms

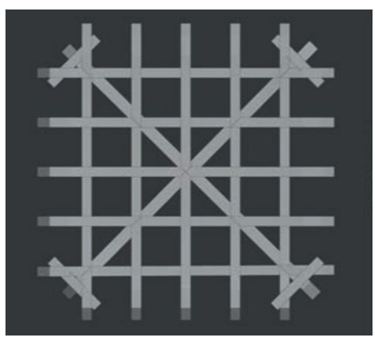
Experiment IV



The first 1:1 model consisted of a total of 16 parts, including 10 seat parts, 2 stabilisers and 4 legs. Next I tried to rotate the grid 45 degrees, produce the legs from only two parts and only use one V4 sheet (851x310mm) for all parts.

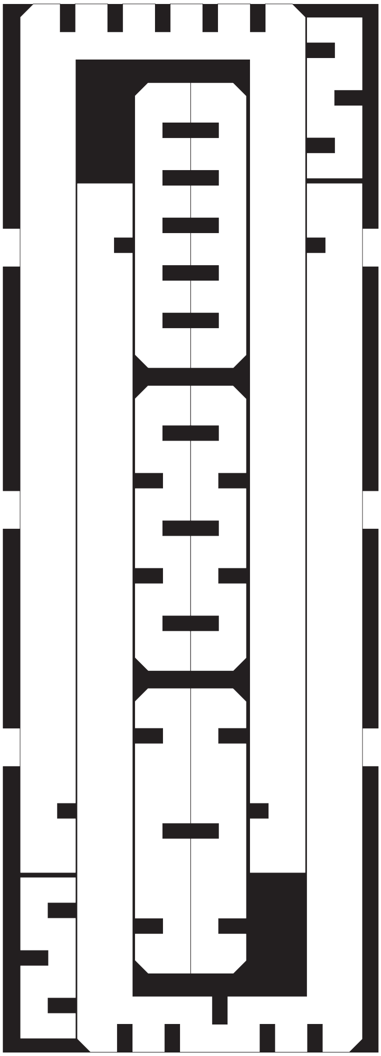


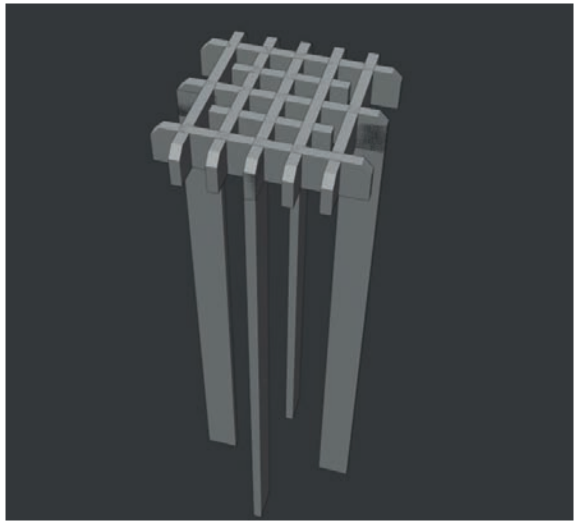


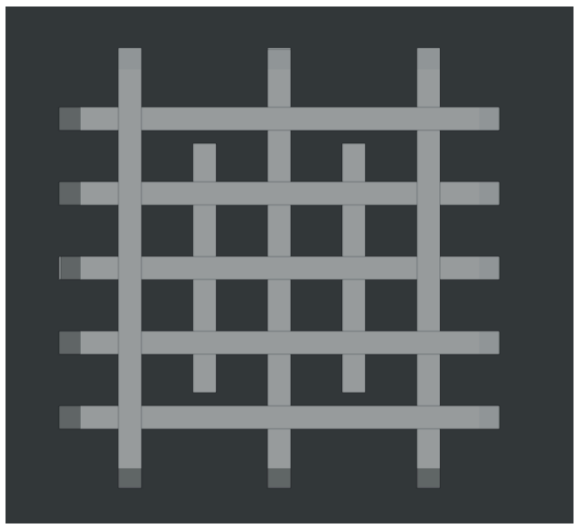


Experiment V

The second 1:1 model consisted of 10 parts, including 8 seat parts and 2 U-legs. It was possible to build a bar stool from only one V4 board, but it has no leg reinforcement. I extracted several cross braces from the remaining parts of the V4 board and used them as connecting elements between the stool legs. But the stability was still too low because the remaining material did not have much mass.



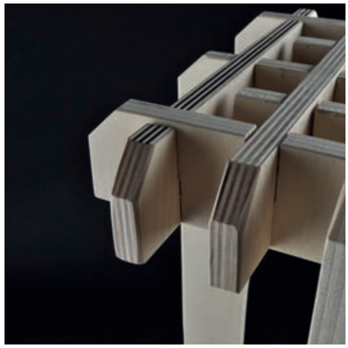




1:1

Because of its slim appearance, I call my final barstool model **Slim Bartender**. Despite its slim appearance the barstool is very stable. Due to its numerous plug connections, the system is self-contained and works without screws or glue. The legs are reinforced by a foot plate, which is made from another V2 piece. The „one board, one chair" concept could therefore not be implemented, but it does provide the necessary stability to sit on the stool.

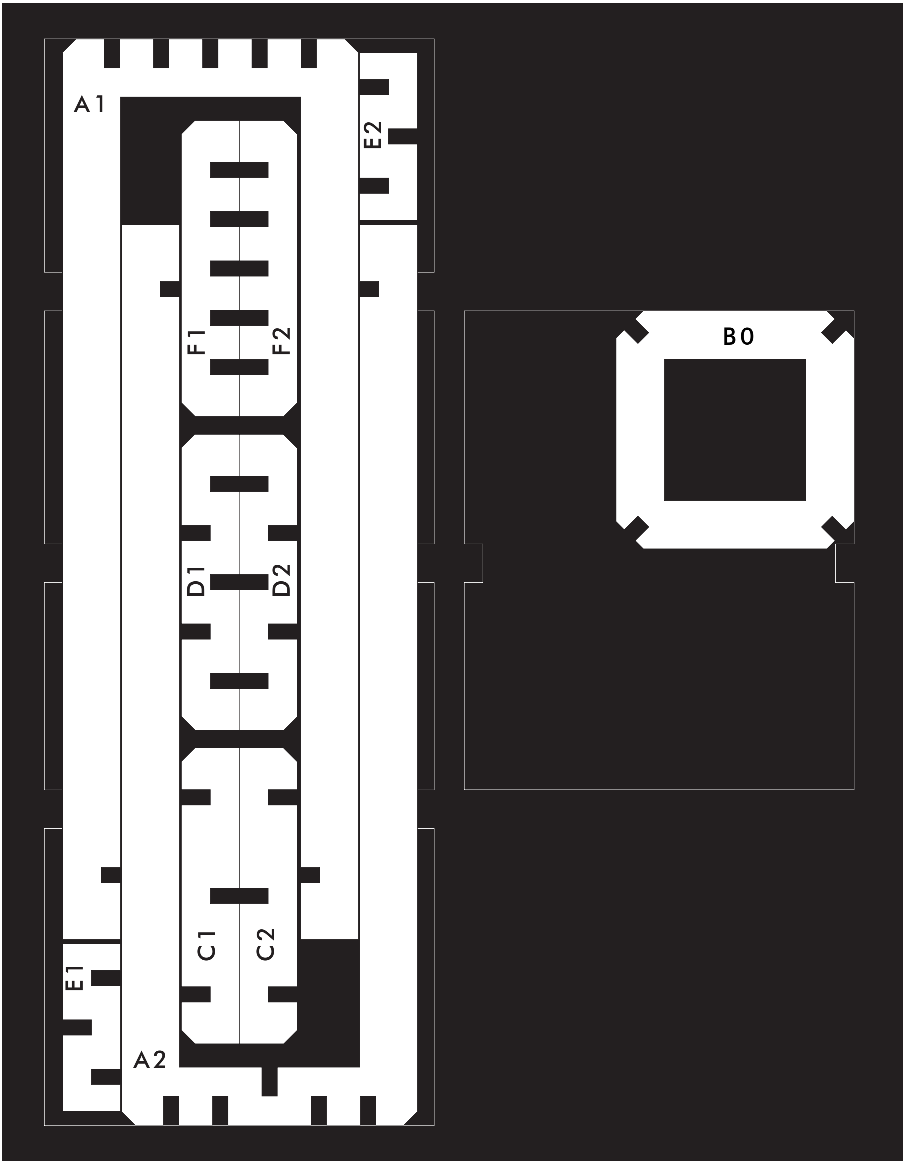
Close Up 1:1 I



Close Up 1:1 II

Close Up 1:1 III

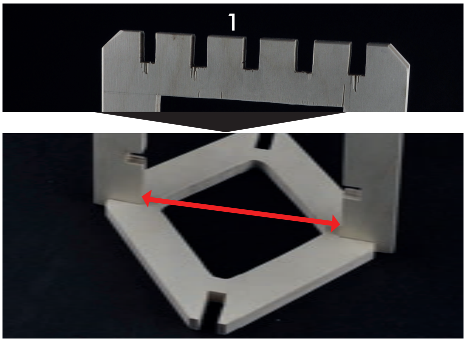
Cutting Layout



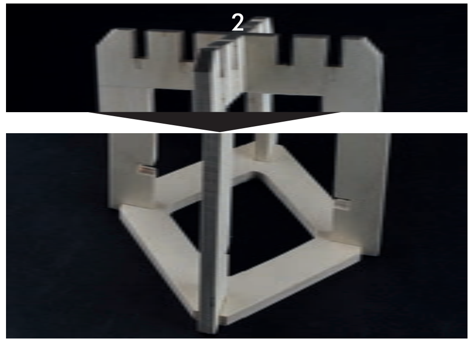
Production & Assembly

The single components are cut out with a milling machine. The sharp edges and the rough and deep areas are sanded down to smooth surfaces. The surfaces are primed with a biocide-containing agent (e.g. Wood Impregnation WR 4001) to protect them from pests and moisture. Finally, the surfaces are sealed with an oil (e.g. Induline SW-910). The stool can also be painted in color on request.

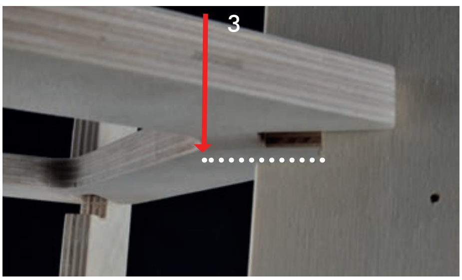
The **Slim Bartender** has six long and two short seat parts (C, D ,E ,F). The legs consist of two U-parts (A1, A2), which are connected crosswise to form two additional seat parts. This results in 10 seat parts and prevents the grid from becoming too large and ultimately leading to an uncomfortable seating experience. Furthermore, this arrangement of the legs provides maximum support for the seat grid (in contrast to experiment number IV). Due to the stabilizing plate (B0) the legs are self-locking and cannot bend or fall off.



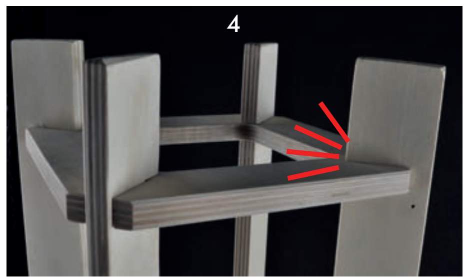
Part A1 is placed on the leg reinforcement B0. The legs of A1 must be stretched slightly to fit into the groove of B0.



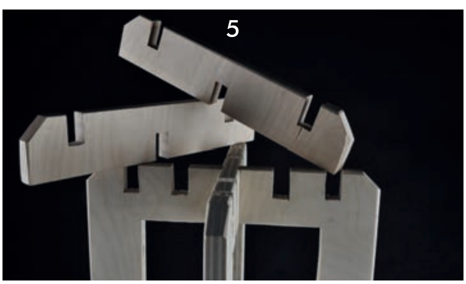
Part A2 is inserted into part A1. The legs of A2 must be stretched so that they also fit into the groove of B0.



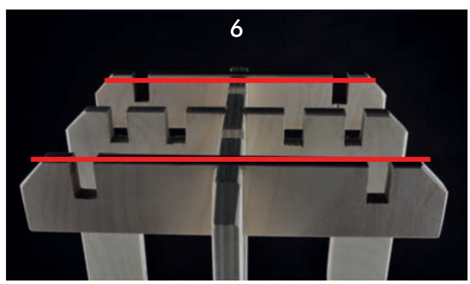
The construction is turned upside down and the leg reinforcement B0 is pushed down evenly so that nothing cants.



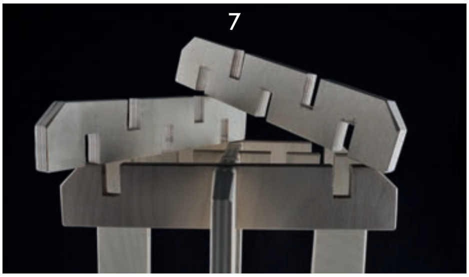
B0 is pushed into the grooves of A1 and A2 until the feet lock into place by themselves.



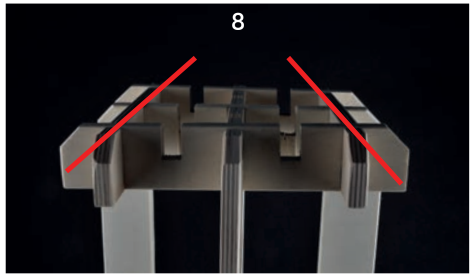
The seat parts C1 and C2 ...



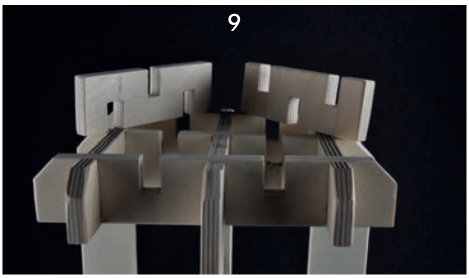
... are inserted opposite each other in the grooves of part A1.



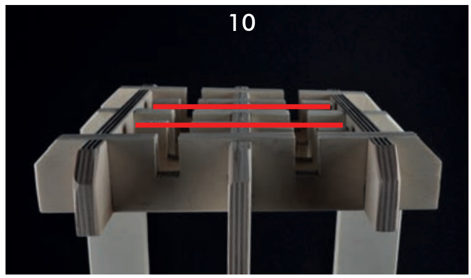
The seat parts D1 and D2 ...



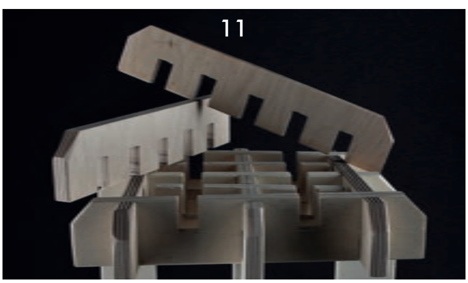
... are inserted opposite each other in the outer grooves of A2 to form a frame with parts C1 and C2.



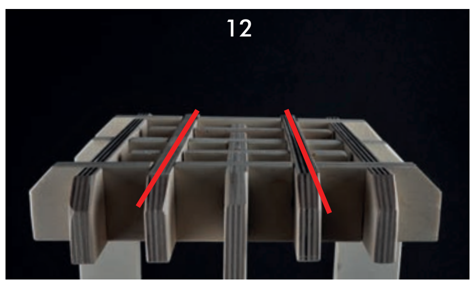
The seat parts E1 and E2 ...



... are inserted opposite each other in the middle grooves of A1.

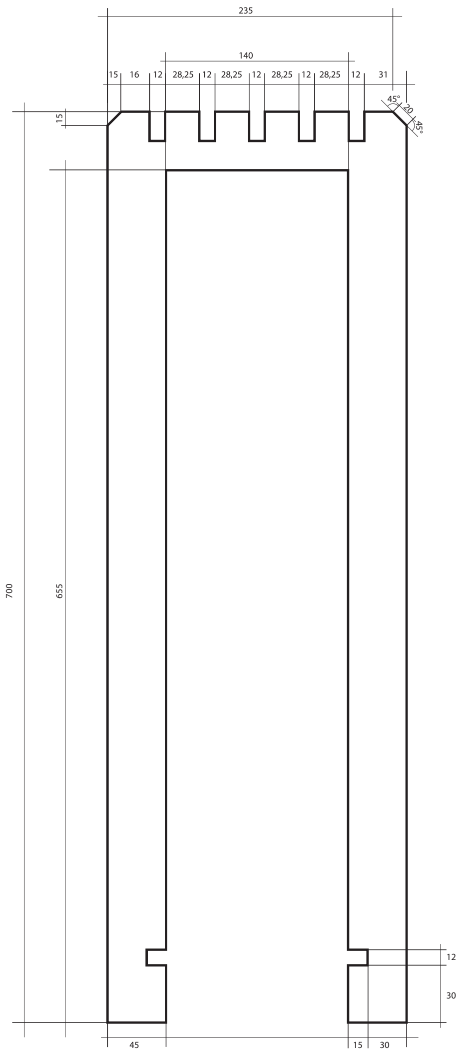


The seat parts F1 and F2 ...



... are inserted into the remaining grooves so that the seat parts lying on A2 are connected together.

Dimensions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15
16
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28,25
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45°
20
700
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30
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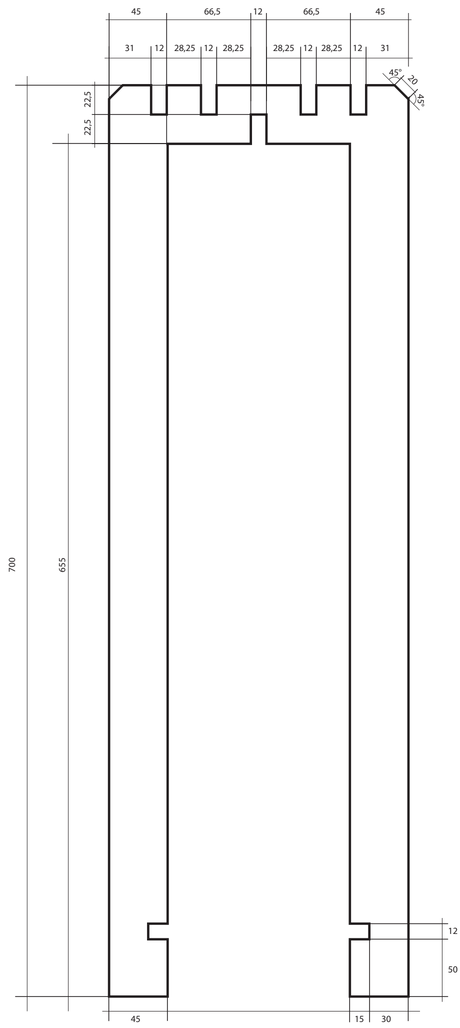
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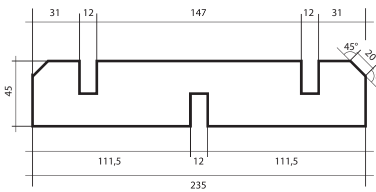
655
50
15
30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45°
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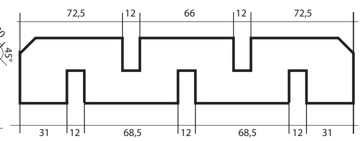
111,5
12
111,5
235

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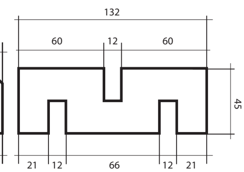
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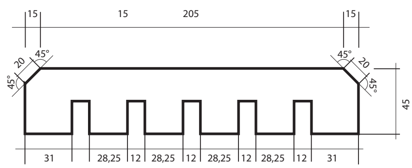
15
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205
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45°
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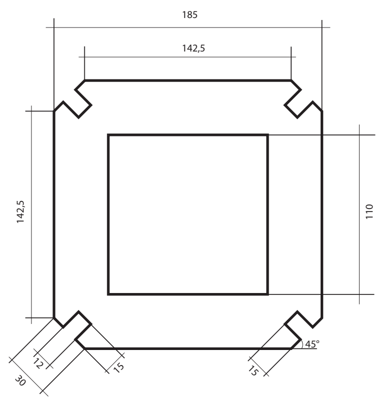
185
142,5
142,5
110
45°
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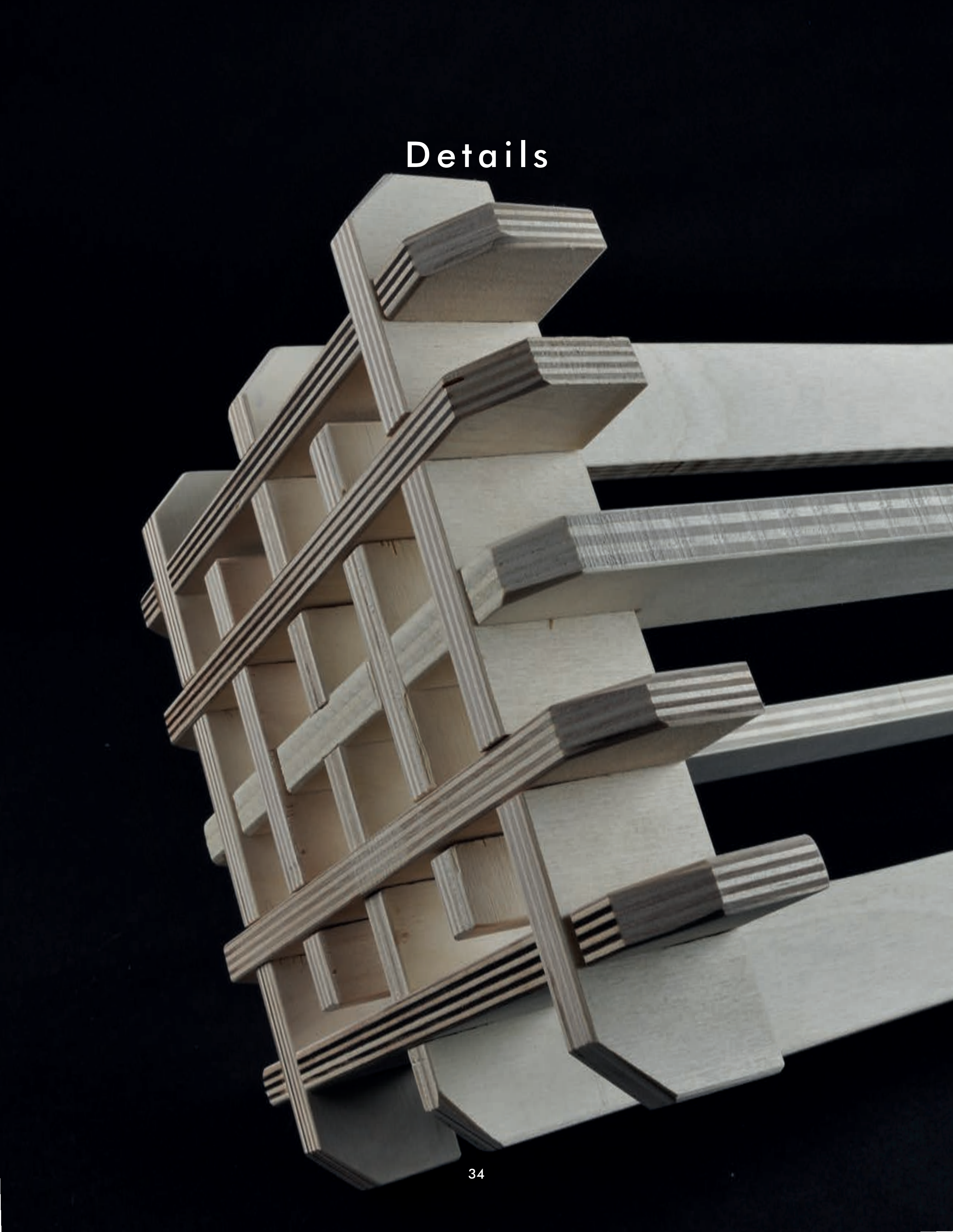
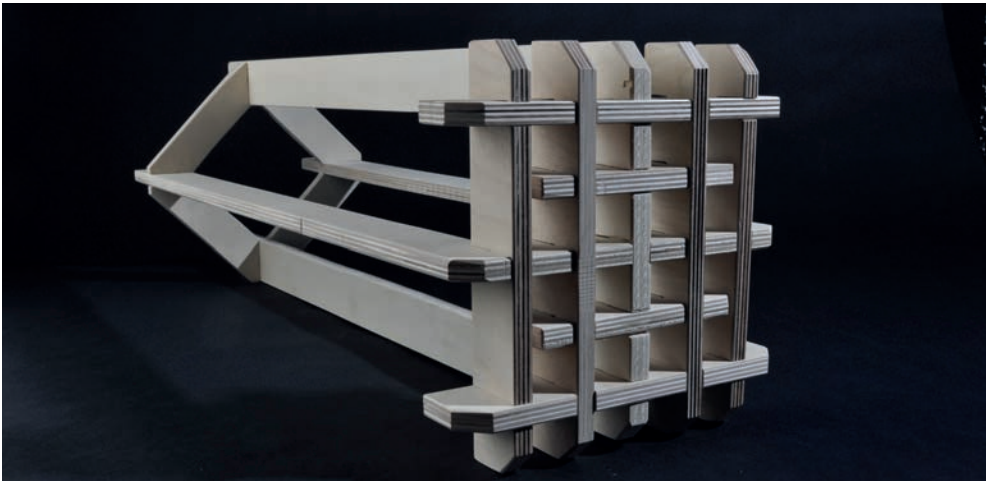
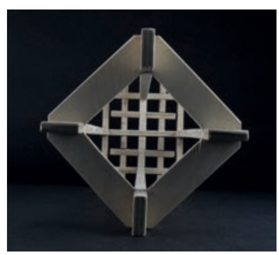
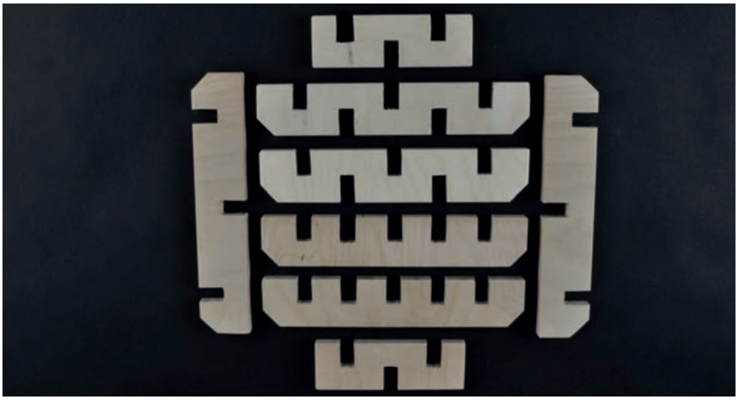
15

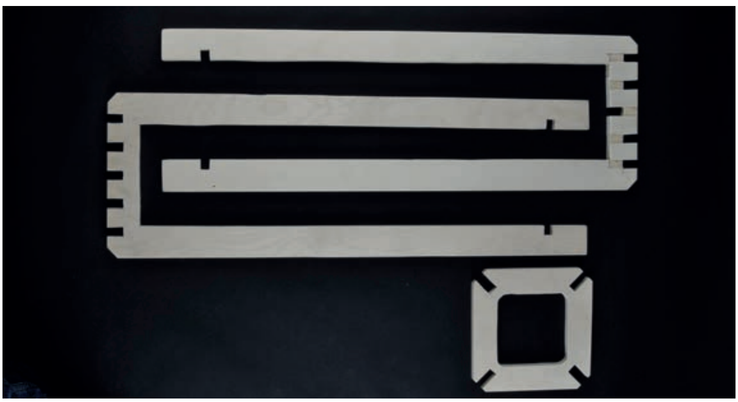
Details

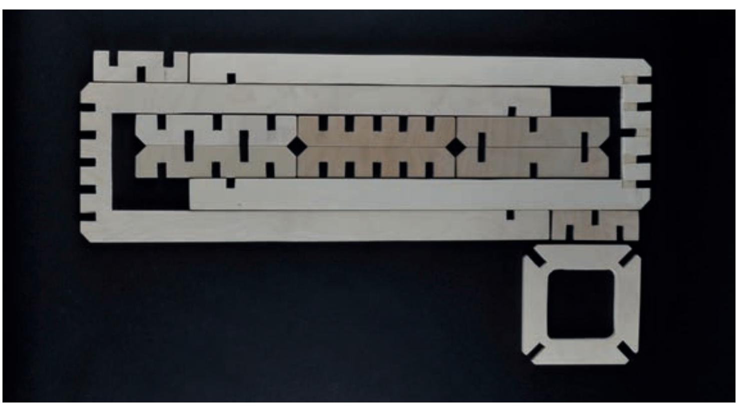




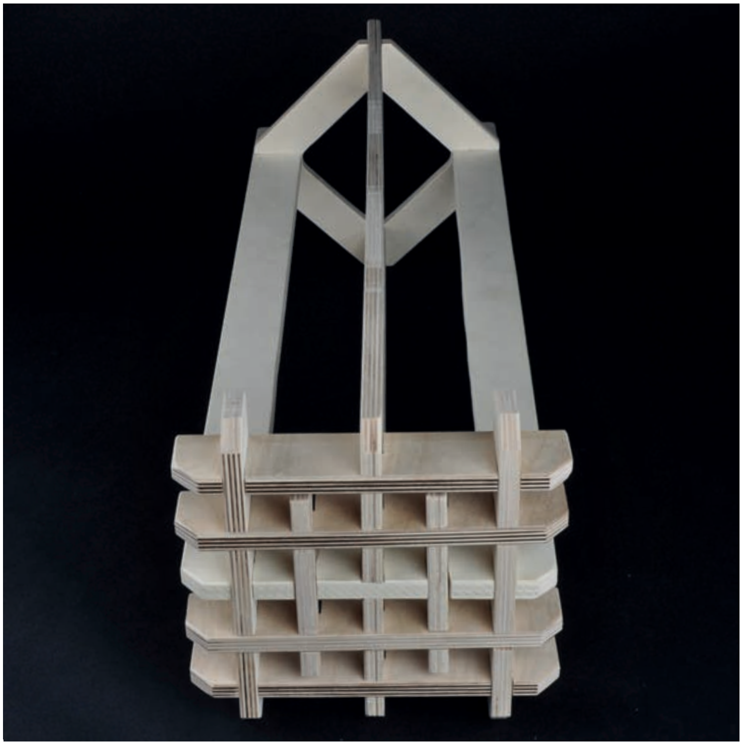








Outlook



After some seating tests I came to the conclusion that the **Slim Bartender** is still about 10 cm too low to be a proper bar stool. With the current seat height of 70 cm you tend to sit a bit unconfortably. If the stool were higher, however, it would need additional reinforcement to ensure stability. Instead, you could lower the legs 20 cm and have a regular stool. With its current size it is also a great platform to place a plant or an object on.

Connex

Markus Franke
Nadine A. Bernhardt

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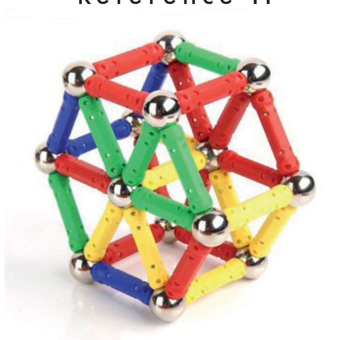
Reference I

Reference II



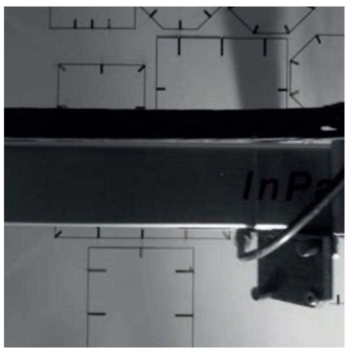
Reference III

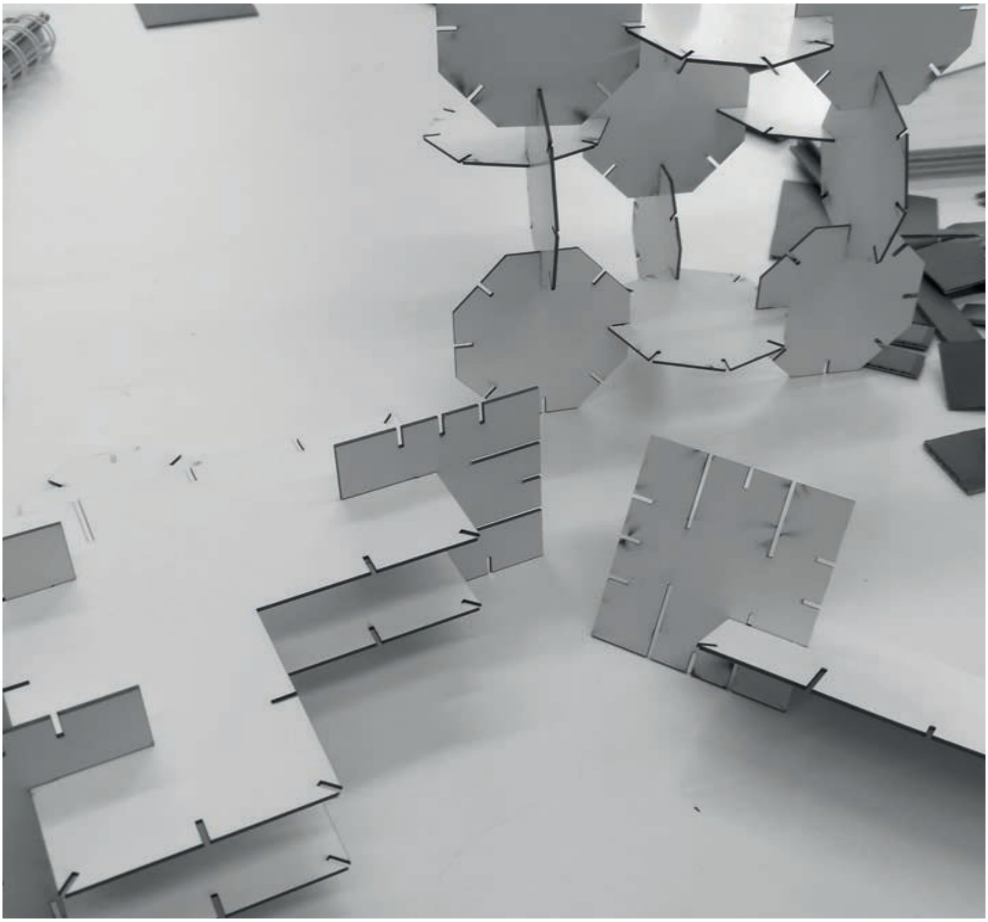
Our Idea and Concept

The Berlin-based company **16boxes** develops system shelves that are designed for efficiency and sustainability. During the production process, wood waste is generated that has no further purpose. In order to maintain the company's principles throughout the entire production cycle, a new use is sought for these leftovers. Our task during the short project **The Aesthetics of Efficiency** was to find a solution to this design problem.

Our approach was to make maximum use of the available material while maintaining the largest possible sheet size. We asked ourselves how we could develop a frame in which we would not have to modify the remaining boards, but still create a working system. It was also important to us to give users the opportunity to build their own furniture by extending or modifying it according to their needs. To do this we had to develop a universal connection system.

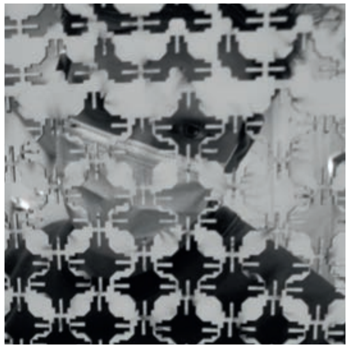
Experiment I

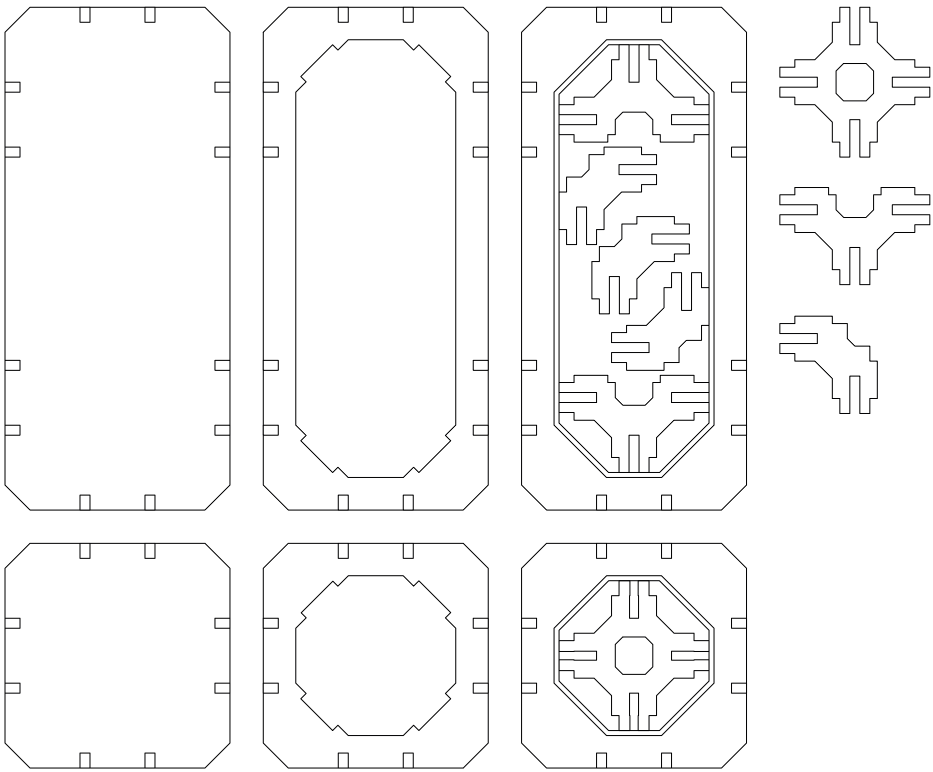




At first we tried to cut into the wooden boards to create connecting points. These are the most stable, but reduce the usable area enormously. Our second approach was to create connections to the outside. These allow for an optimized usable area, but have stability deficits. We combined both approaches to develop our present idea.

Experiment II





To build an expandable furniture we needed connectors with four openings. This allowed us to cover all dimensions, depending on where the connector was placed. We modified this original shape to round off the end and corner pieces of the final construction. This allows the system to be closed at the sides. The shape of the connectors results from a material reduction approach. The less material is used, the lighter it becomes, however, also the stability suffers. Here we chose a balanced compromise for the best possible result. To speed up the CNC process, we decided to simplify the edges even further.

Our Process

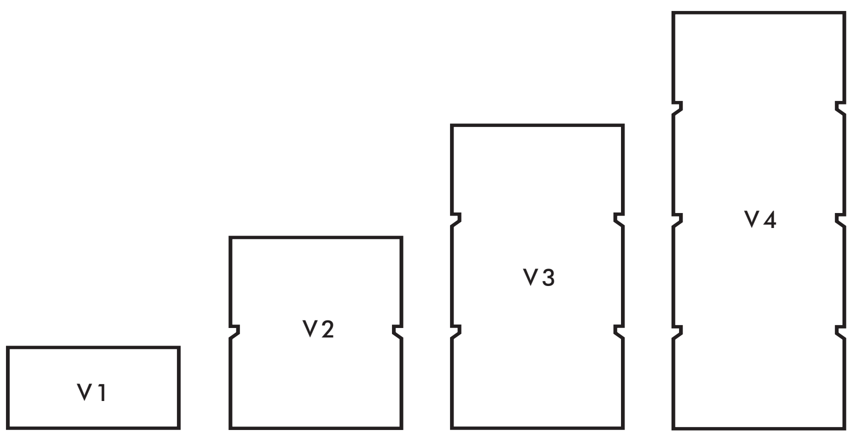
Now that we had developed a functioning connection system, we needed the right material for production. We didn't want to cut into whole wooden boards, as this wouldn't solve the demand for efficiency. Based on the **16boxes** system we created frames for the outer walls of the furniture, which provide stability. The new remainders are ideal for further processing of the connectors. There is still potential for optimization to save even more residual material.

In the following we dealt with the wood cut-outs. On the basis of tests we developed these conclusions: The deeper the cut into the panel, the more stable the connection. It is also possible to make adjacent panels flush. However, the effectively usable area suffers again. The wider the cut, the easier the furniture can be assembled. But here too, stability suffers if the cuts are too large. Even the smallest changes in the range of millimeters can have a major impact. This is a positive finding, as the user experience can be calibrated precisely. Sanding the top and bottom of the panels also has an influence on friction, so the sanding process must be taken into account.

Ultimately, the cuts serve as a guideline that facilitates but does not restrict the assembly. We have made no changes to the thickness of the material. The present material is very stable and ideal for universal use in furniture. Our prototype with the compact V2 panels carries the weight of an adult person.

The **16boxes** series consists of four size variations from the smallest (V1) to the largest (V4), as can be seen in the diagram on page 10. Our product uses V2 and V3. We adjusted the size of the connectors so that two V2 panels plus one connector are exactly the same length as the V3 panel. In this way the pieces can be combined. The implementation of the V1 and V4 plates is also realistic because they follow the same scaling logic.

The aspect ratio of the panels influences the function. Square panels are most functional because they can be easily attached in all directions (e.g. to create closed shapes). However, the usable area is limited. It is also more difficult to minimize leftovers because boards have to be cut. In contrast, we have used the original aspect ratio of the boards. These are limited in their function. Especially when using V2 and V3 boards in combination, there are limitations in the assembly. But here the usable area is the largest and the material consumption the most effective. We chose the latter variant for our prototypes because it supports our concept of optimized material usage. For clearer results further experiments are necessary.

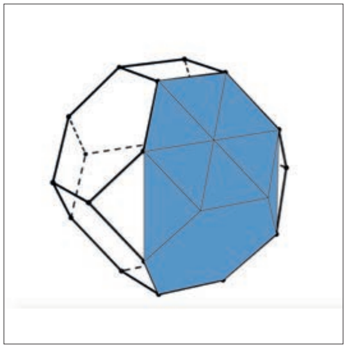


Residue plywood cut-outs

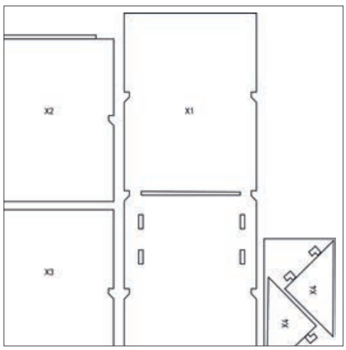
1:1

Connex is a plug-in system that enables its users to design furniture according to their individual needs. Our concept is based on user experience, multifunctionality and modularity. Material usage and functionality as well as weight reduction are important design principles.

Close Up 1:1 I

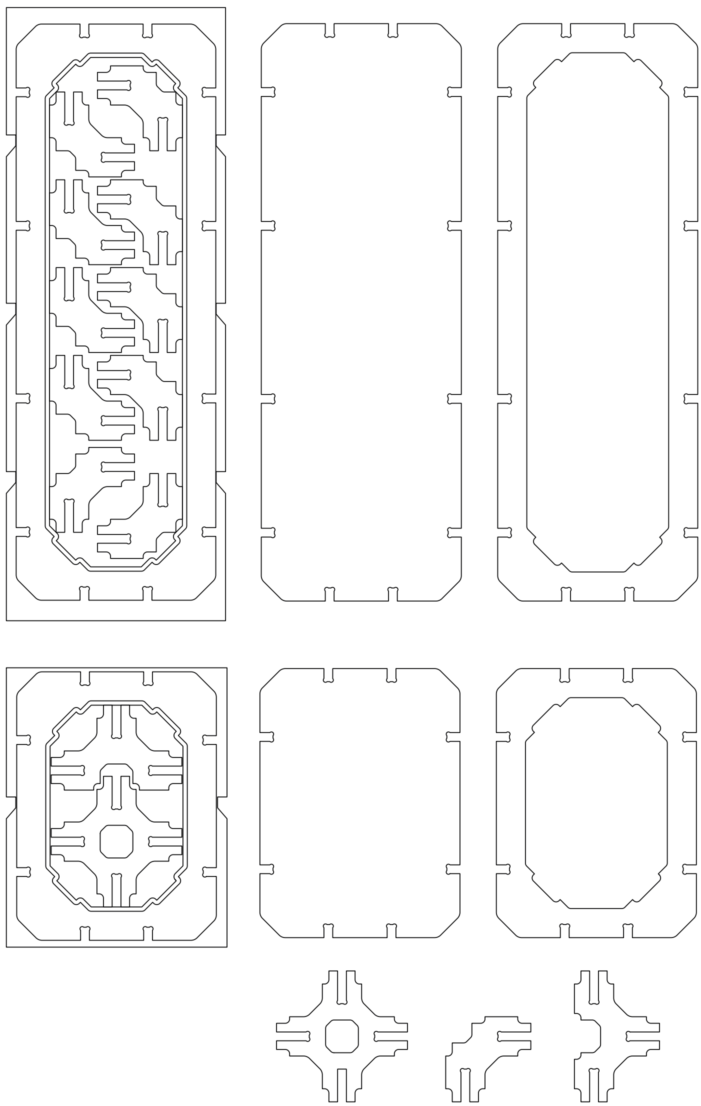


Close Up 1:1 II

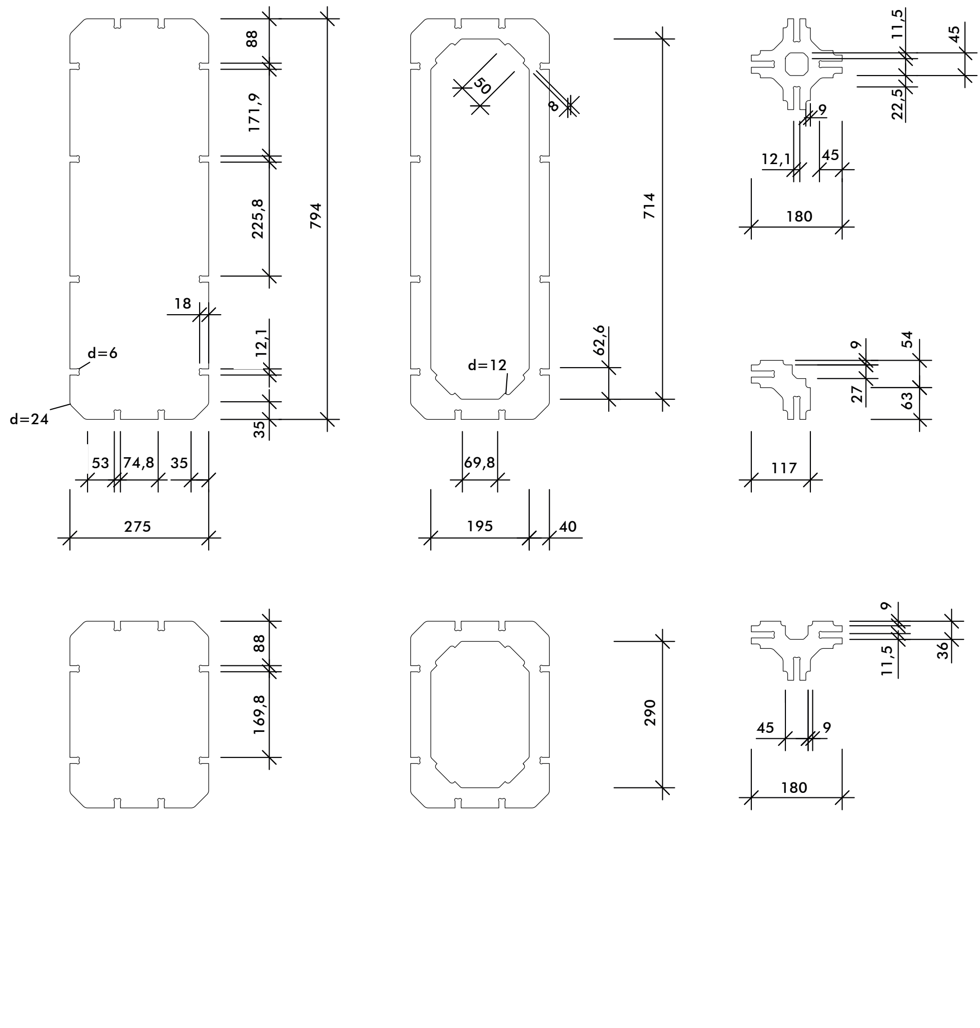


Close Up 1:1 III

Cutting Layout



Dimensions


88
171,9
225,8
794
18
12,1
d=6
d=24
35
53
74,8
35
275
50
8
714
d=12
62,6
69,8
195
40
11,5
45
22,5
9
12,1
45
180
9
54
27
63
117
88
169,8
290
9
36
11,5
45
9
180

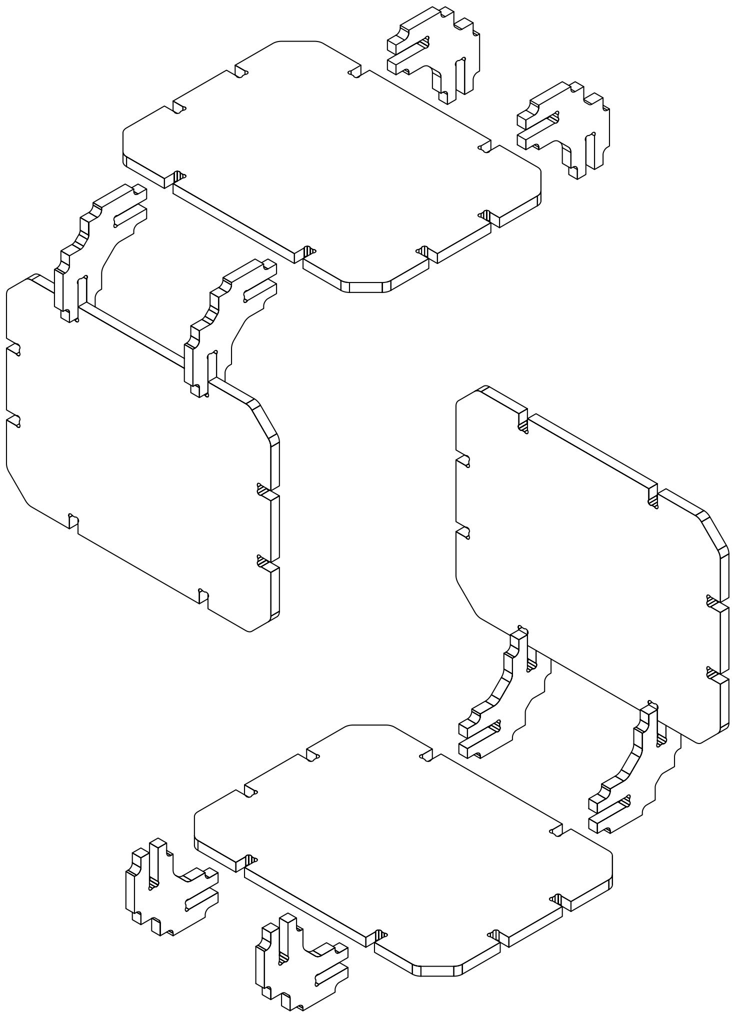
Production

Each **16boxes** wooden board makes one Connex board. If a side panel with a frame is produced, a V2 leftover piece covers a 4-way and a 3-way connection. From one V3 board ten 2-way connections are produced. This ratio is deliberately chosen because the 2-way connections are used the most. An optimized form of the elements would allow any remaining material to be used up.

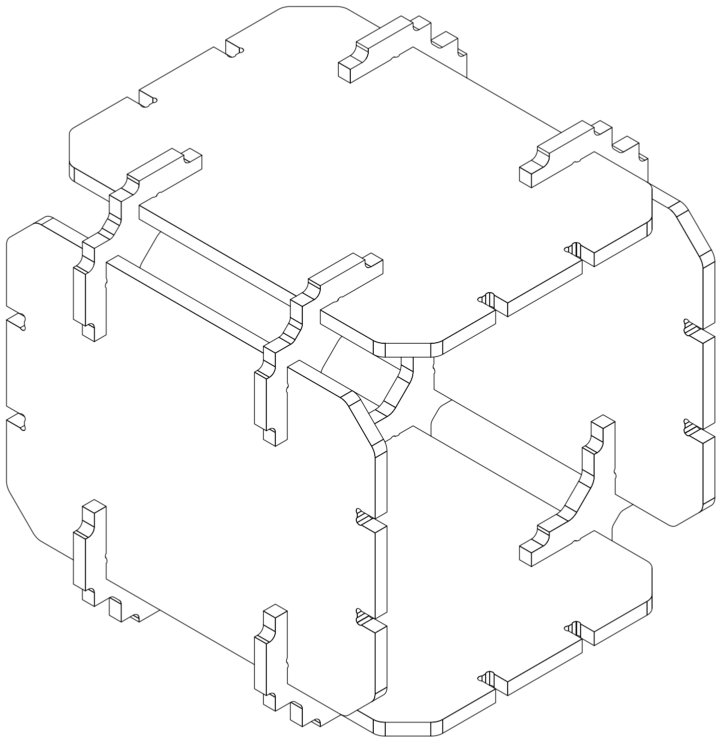
Our system can be adapted according to the needs of the users and the available space. For example, it can be used as a shelf, night cabinet, small stairs or table. If a part of the system is not needed, it can be easily disassembled and stored.

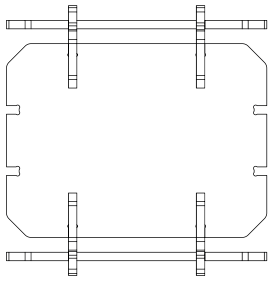
Transportation is also convenient as identical parts can be easily stacked and all elements are flat. Users are given the opportunity to adapt the furniture to individual needs and discover new functions. As a result, it gains in personal value during further use.

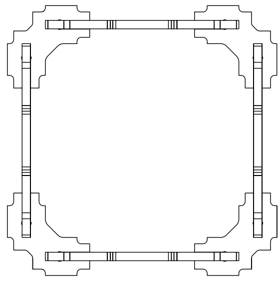
Assembly

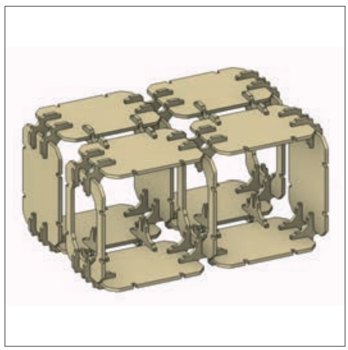


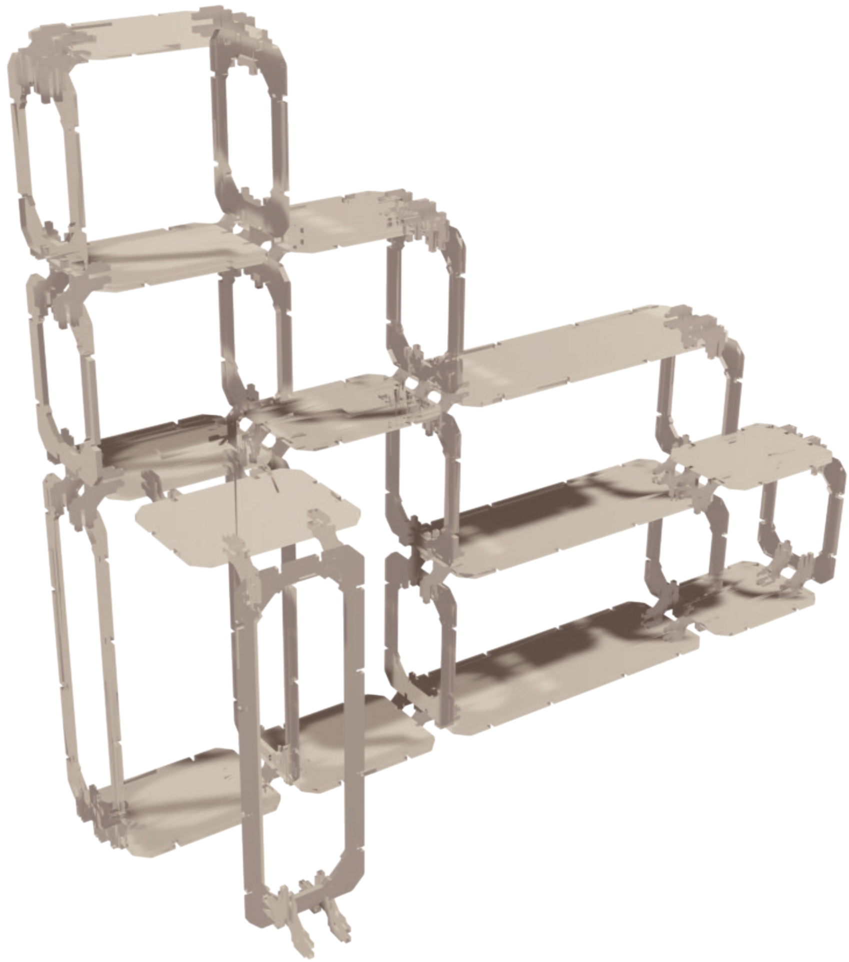
Details







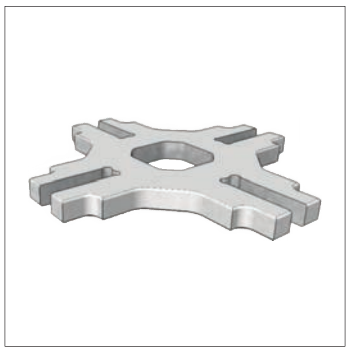




Connex removes existing restrictions and creates a new perspective for the use of residual material. Our product can be used for almost any application. The playful principle awakens the creativity of the user and opens up interaction. The material is used to its fullest extent while retaining its functionality, stability and size.

Variability of connector-shape

Extension for building specific furniture

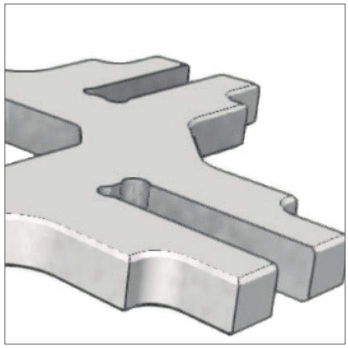


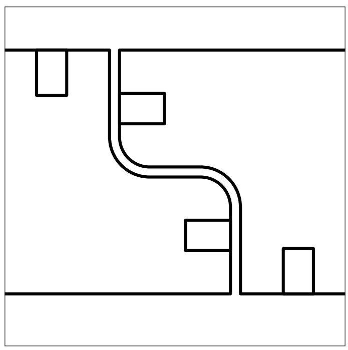
Expansion in the third dimension

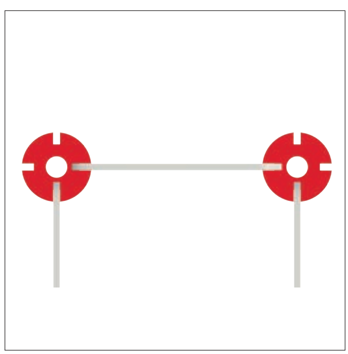
Outlook

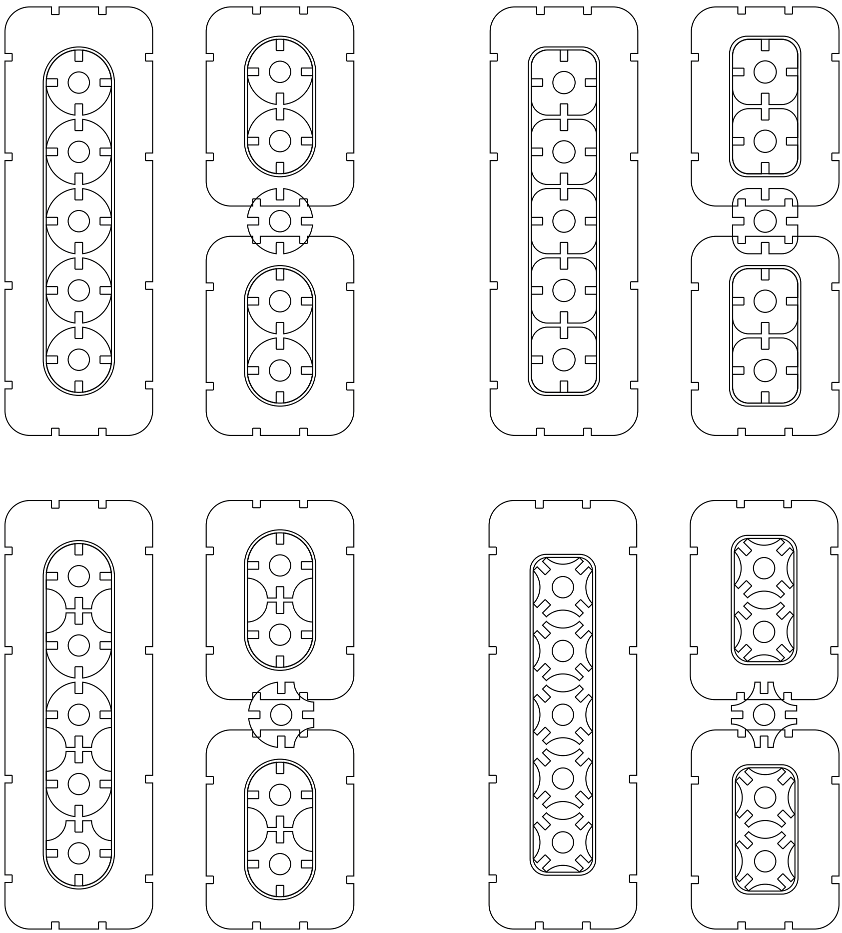
Yet, the system can still be improved. As mentioned above, the shape of the connection elements should be further adapted to the CNC process. In addition to the existing elements, other parts such as rods or round shapes can be experimented with. Larger boards offer the possibility to include hooks on each side. Similar to the **16boxes** system, this would allow for the implementation of storage boards that are not connected to the frame. Lastly the friction between the board and the connectors can be optimized to guarantee the best user experience.

Variability of connector-shapes



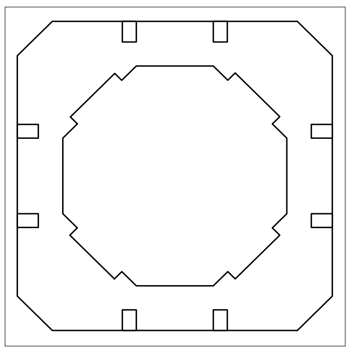


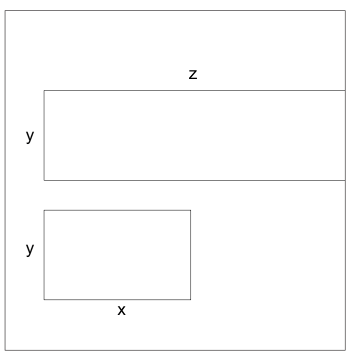


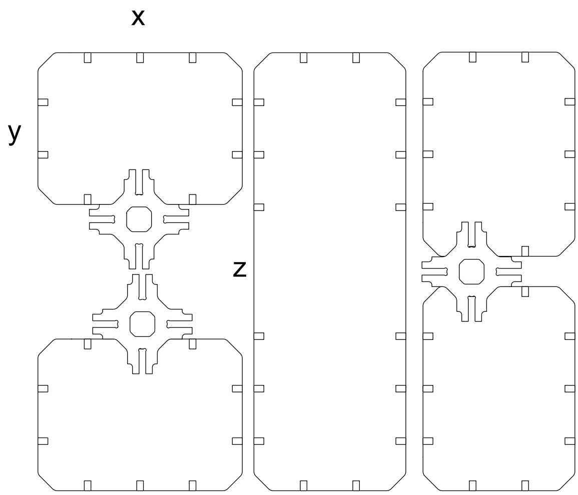


The CNC process can be accelerated mainly by shape variation. The shapes must be rounded as much as possible to ensure faster production times. In order to save material, a larger intervention is necessary. The use of multiple connectors leads to complex nesting and more excess material. Therefore, the optimal solution would be to use only one connection element. However, aesthetics suffer from this approach because the corners of the construction do not run smoothly.

Expansion in the third Dimension







If you look at the problem in the upper graphic, you can clearly see the difficulty in modularity. In this case, a rectangle with two different lengths can only be adjusted on one side. Because of the width of the boards we work with, the panels would decrease so much according to the formula below. A length of 95.4 cm is not given with the residues left of **16boxes**, so we see potential in the use of squares. In our experiment I we tried it and it worked perfectly. We decided to use all of the given material and not to produce even more leftover pieces, so we chose the rectangle for our prototype. After all, this is an interesting field to deal with in further process.

$$2*x+7,2 = 3*y+14,4 = z$$

$$x = 1,5*y+3,6$$
$$y = 2/3*x-2,4$$

for y = max.27cm is
x = 44,1cm
z = 95,4cm

Outside the Box

Marek Runde

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Reference I

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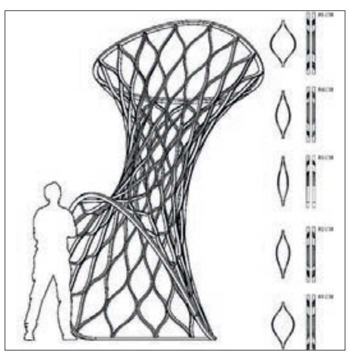


Concept

Plywood enjoys great popularity. This is not least due to the relatively low cost and easy processing of the material. Plywood is not only unbelievably stable, but also extremely torsion-resistant compared to an ordinary board. Due to the crosswise glued veneer layers a board stiffens itself practically by itself. The imperfection and dynamics that wood brings as a natural product are deliberately erased here. Large surfaces and sharp angles are no problem for the material. It is made for it.

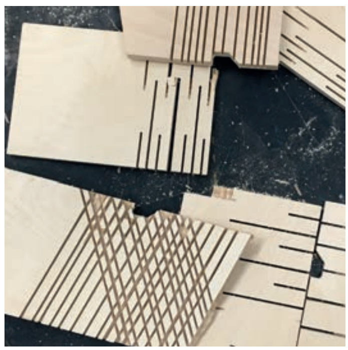
At the beginning of the project it became quickly clear to me that although I appreciate these properties, I also perceive them as severe limitations. Round shapes and soft edges are rather difficult or even impossible with classical joining and processing techniques. This raises the question of how to push the limits of this conventional material and release its full potential. How is it possible to change the properties of the hard, straight material in such a way that organic shapes can be created? What can I do to achieve flexibility and plasticity? Simply joining straight surfaces was not enough for me. If you look at modern design, the edges are usually round.

How can the limits of the material be shifted
and the conventional use extended?

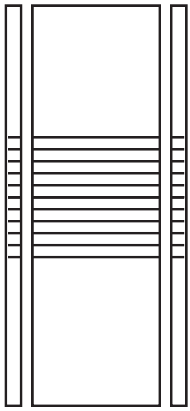
How can I react to more design requirements
with the same material?

The surface can be changed by the intended local weakening of the material. In combination with compression, tension and/or torsion this leads to a different, much more dynamic quality of the material. These properties lead to unexpected creative and constructive possibilities. The tensile or spring force in a plate can be used to produce curved constructions, the newly acquired bending and pliability has a positive effect on the ergonomics of products, and through the mutual distribution of bending constructions, large self-supporting constructions can be created even with relatively small parts.
The method used for this project is called kerf bending and is acquired by using various cyclic saws.

Workshop Tests

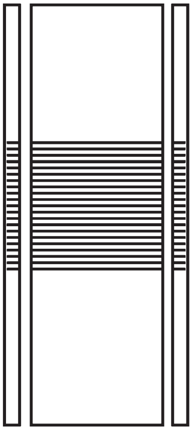


Kerf Pattern 1



Note the polygons that form due to the low „resolution“. Also the achievable bending radius is quite large in diameter. The edge seems to be very stable and tough. Using this technique when bending results in a product with tension and stored spring forces.

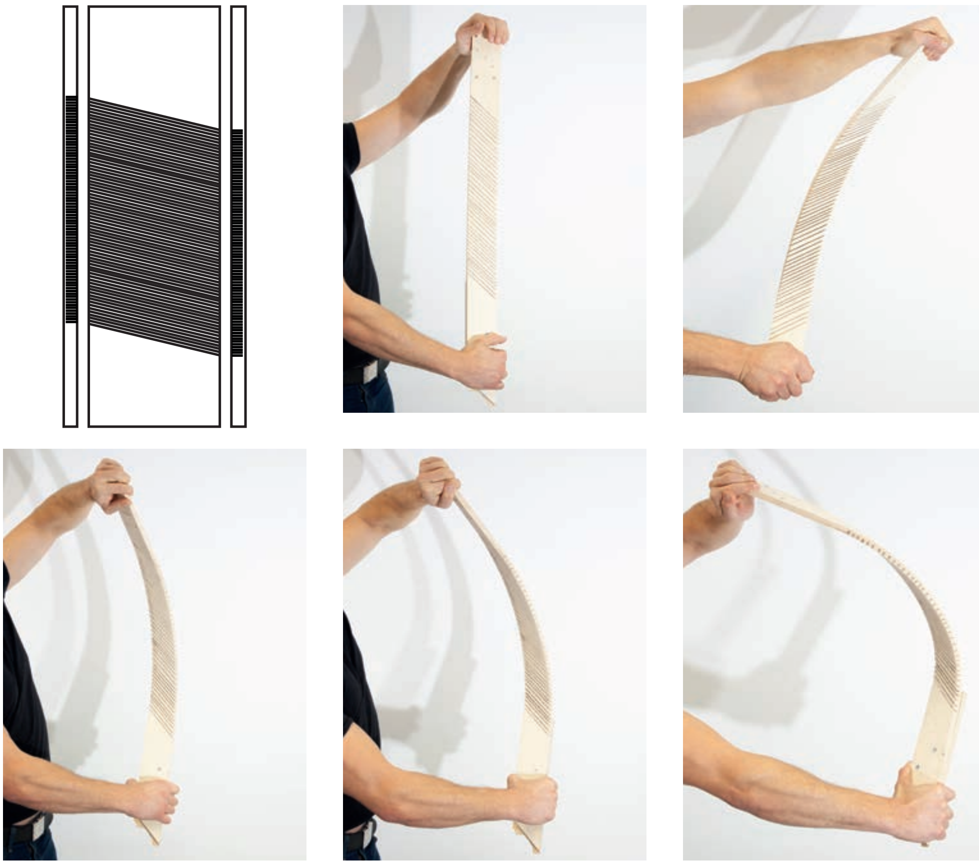
Kerf Pattern 2





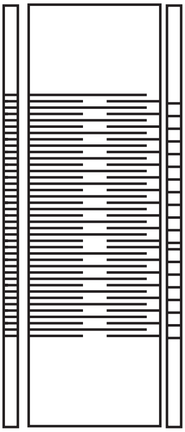

The higher density of the kerfs allow a sharper angle and a smoother curve. The outside of the curve looks nice and even, no additional sanding is required. As in the first example, the bending is done because the remaining two thin layers become flexible. The radius is then limited by the remaining thick parts. The additional kerfs on the outside are part of an additional experiment.

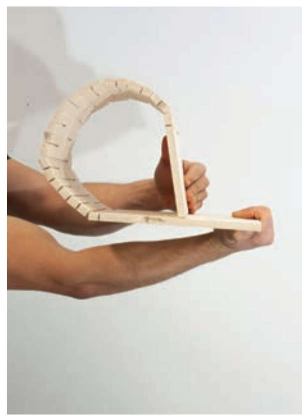
Kerf Pattern 3



Note the diagonal cuts. Bending this board not only creates an edge in one direction, but in two dimensions at the same time. One dimension has just been given to us. Due to the length of the bent surface, quite strong forces are required to hold the product in its final position.

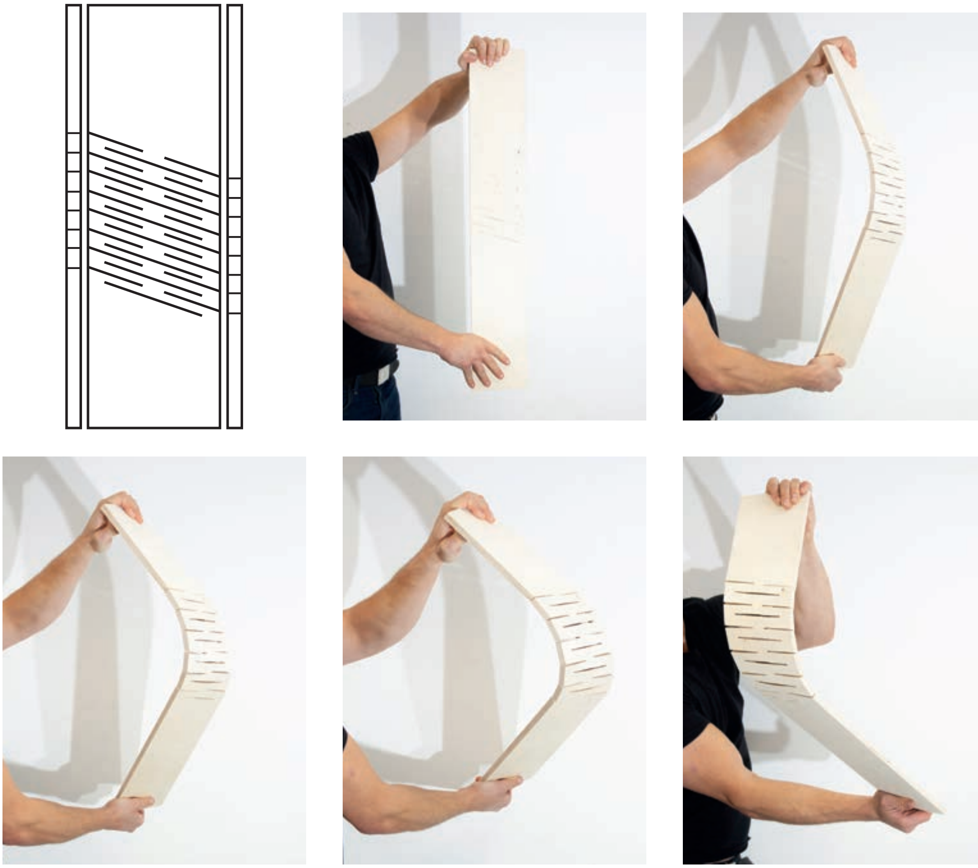
Kerf Pattern 4





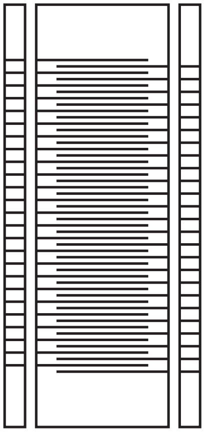
Unlike the other techniques, this technique cuts through the wood completely. Bridges are not left here in the thickness, but along the cuts. This results in a tighter bending radius and less pretension, so that less force is needed to bend the product. When sawing this pattern with a circular saw, it is advisable to add a jigsaw to remove the radii left by the blade and to be able to cut up to the mark.

Kerf Pattern 5



This product is a further development of the second one. Here, the change of the inclination angle and the slot-no-slot technology are combined. The result is a product that is much more ductile on a shorter distance with less force. Note the dipped cuts, this results in a more durable pattern than product 3.

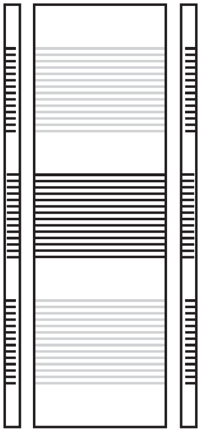
Kerf Pattern 6

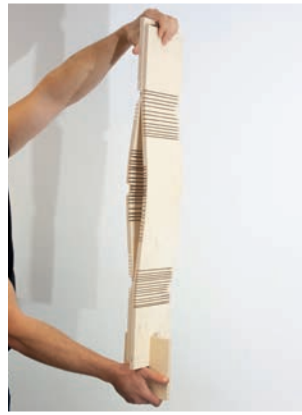





The board, which is sawn alternately on both sides, can not only be bent in two different directions, but can also be shaped multi-dimensionally in the manner of a helix. Due to the chosen technique of sawing through the board, the force required for the deformation is minimal, but the load and tension in the longitudinal axis is also minimal.

Kerf Pattern 7



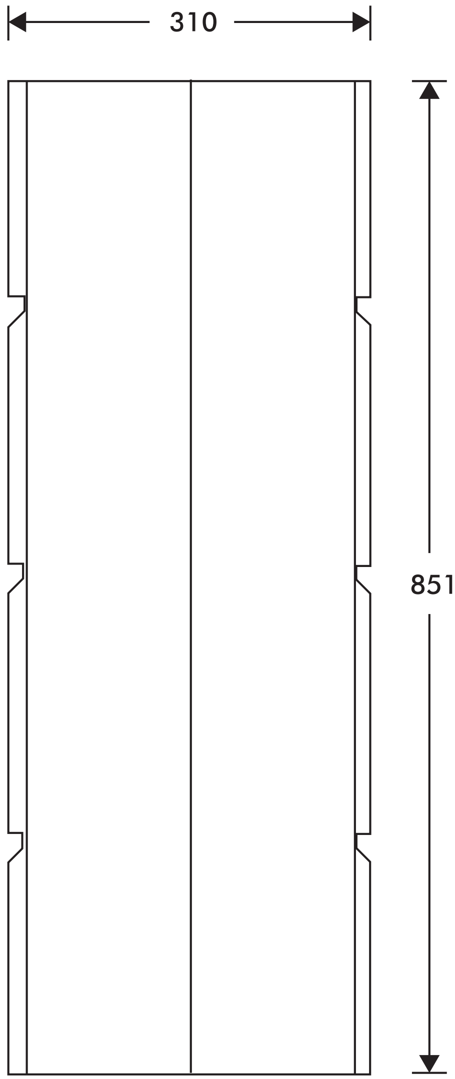



The most exciting attempt was the alternate cutting of the board. The resulting interactions and the resulting radii form a kind of loop spring. If the middle part of the board is cut diagonally, you get a convex or concave scarf, which is inclined differently depending on the angle. Dome constructions, for example, can be realized from several different elements of this type.

Outside The Box

The results of this project are mainly insights into the way plywood can be rethought and the potential of this material can be further developed. Through the use of digital techniques, there are many more ways to kerf the plywood, allowing an almost unbelievable three-dimensionality. I am amazed at how far the limits of the material itself can be shifted even by crude means.
During my experiments I not only experimented with depth and patterns but also with the inclination of the material. By changing the angle of Inclination of the kerfing to the longitudinal axis of the plate, the angle not only changes in the Y-direction but also along the Z-axis during subsequent bending. This means that by changing the two-dimensional manufacturing process, complex three-dimensional changes can be produced that are predictable. One is thus given a dimension as a gift. This insight was the most exciting for me.
For a kerfing with a 50 degree angle, I get an angle of inclination (in the Z-direction) of about 15° on a length of about 12 cm for a 12 mm panel, a saw blade width of about 2 mm and a center distance of the grooves of about 4 mm.
The fineness and distance of the kerfs from each other is, so to speak, the „resolution". Less distributed over a large distance results in a rather polygonal curve. If you increase the density of the kerfs per distance the curve becomes smoother and more even. With a high density you get an almost perfect radius, which can be further optimised by grinding.

Cutting Layout



Production

First you need to draw the desired pattern.

For the first technique, adjust the width of the kerfs to your individual needs. For a smooth rounding I recommend a gap as wide as your blade is thick, in my case 2 mm.

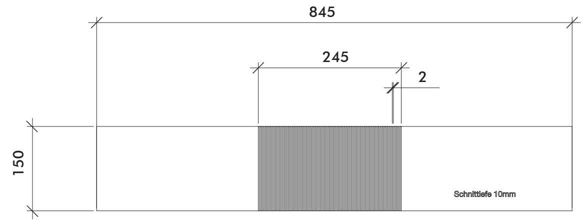
For the second technique I used a 20 mm gap between the cuts. The length of the pattern depends on your specific needs and the radius you are aiming for.

For at home: Use a fretsaw. Depending on the format of the components, either a crosscut saw, a plunge-cut circular saw or a table saw with height-adjustable blade and fences.

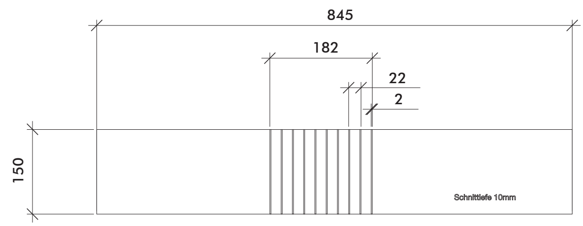
The second technique also requires a jigsaw to get to the marked patterns and remove the radius left by the circular saw.

For automated production: Use a CNC milling machine and a computer. Important for the first technique (the tension based one) is that you set the cutting depth so that at least the last two veneer layers are left.

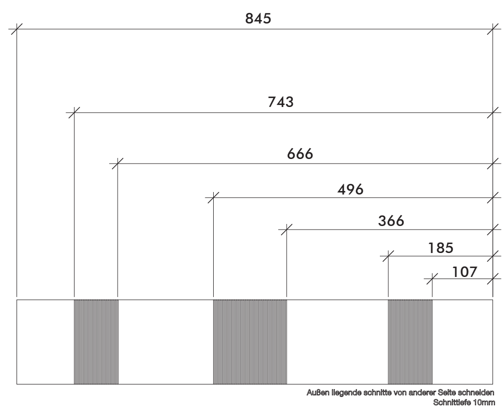
Dimensions



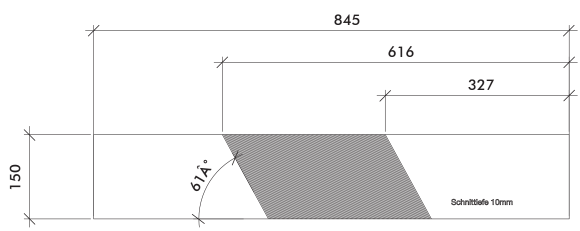
845
245
2
150
Schnittiefe 10mm



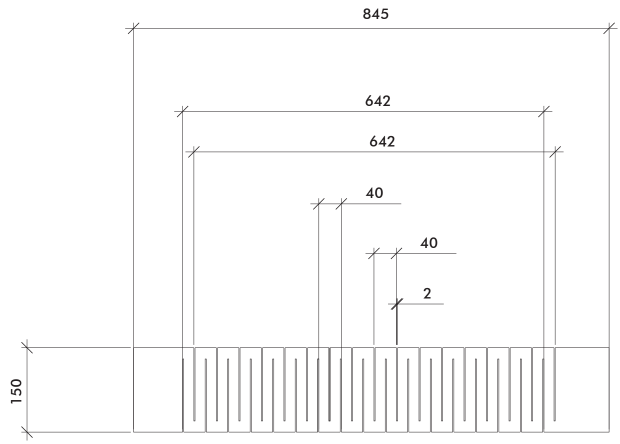
845
182
22
2
150
Schnittiefe 10mm

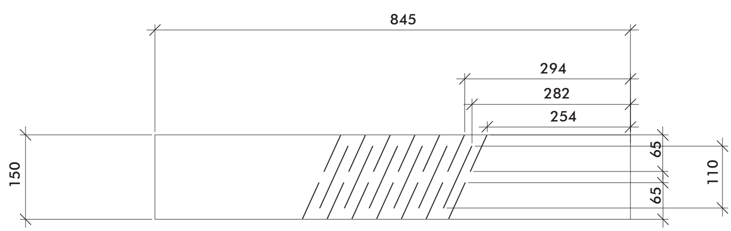


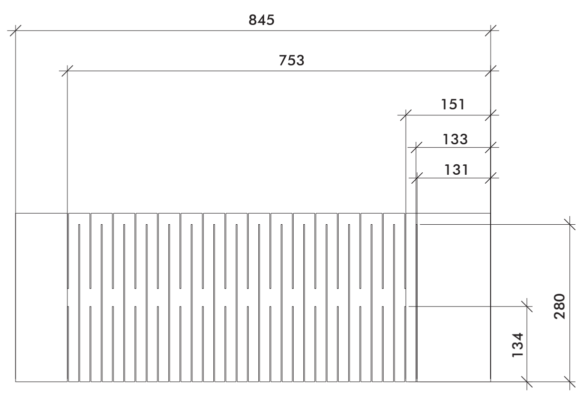
845
743
666
496
366
185
107
Außen liegende schnitte von anderer Seite schneiden
Schnittiefe 10mm
Schnittiefe 10mm

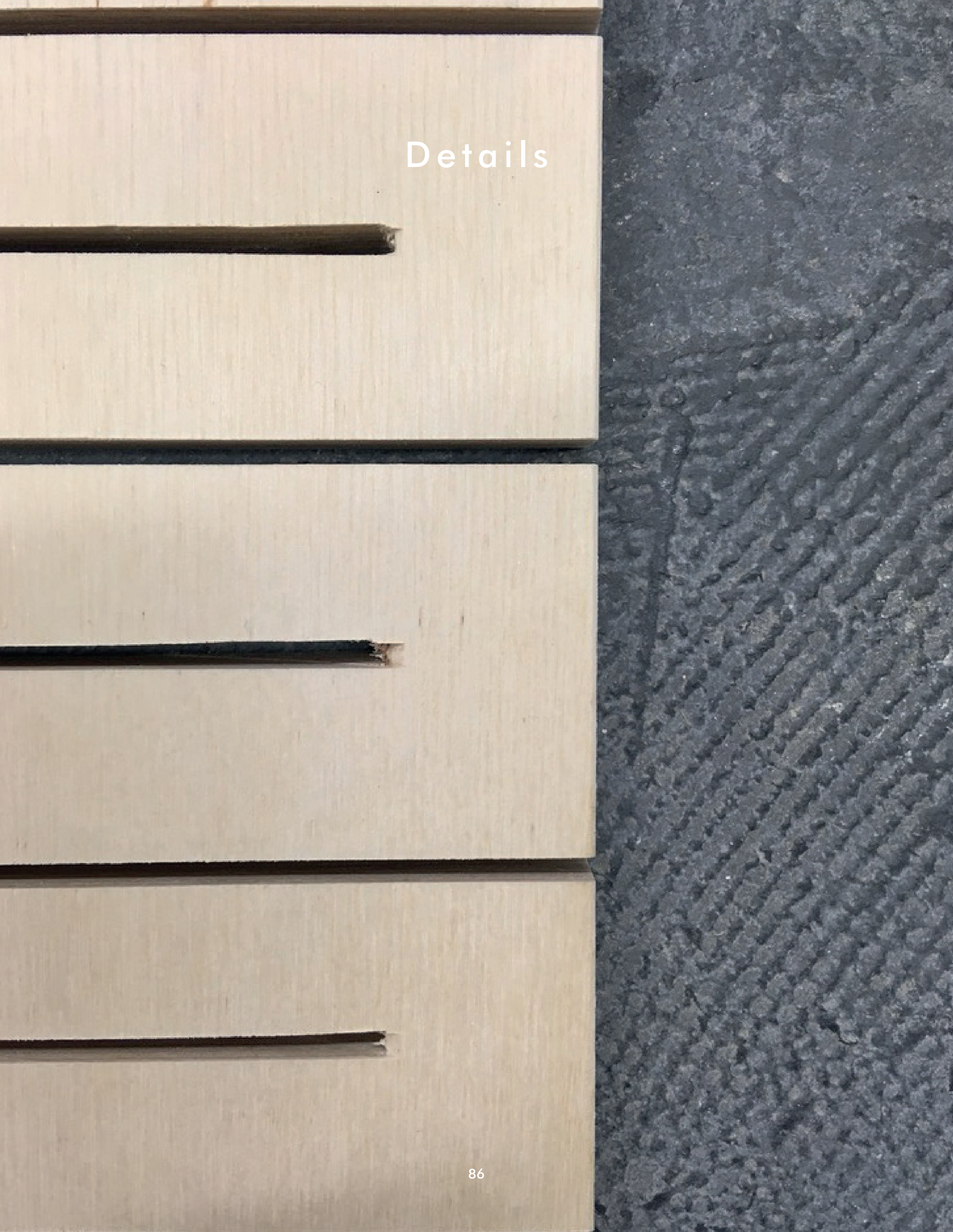


845
616
327
150
61Â°
Schnittiefe 10mm

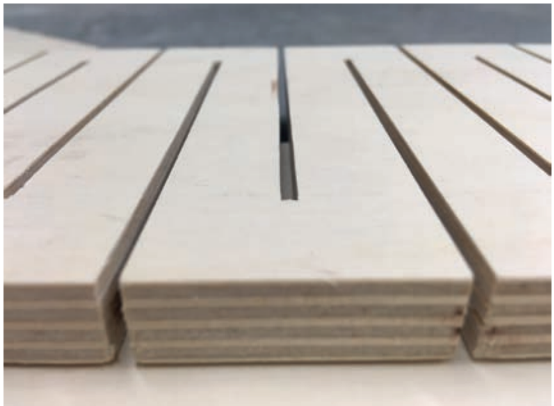

845
642
642
40
40
2
150


845
294
282
254
150
65
65
110

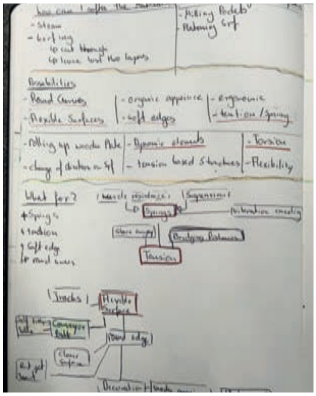

845
753
151
133
131
280
134

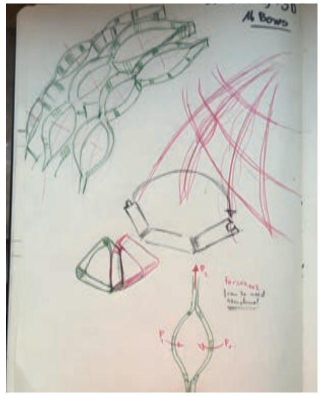


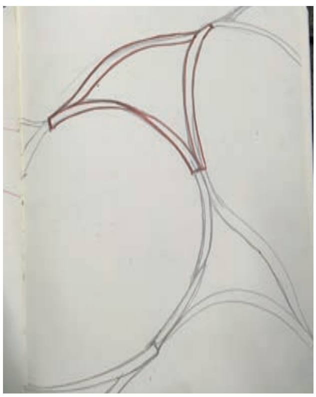
Details

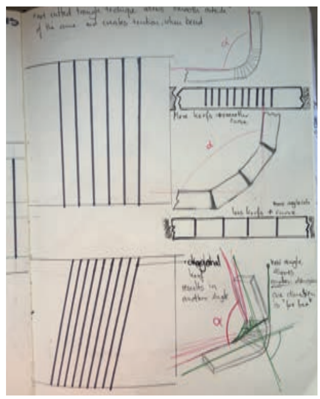


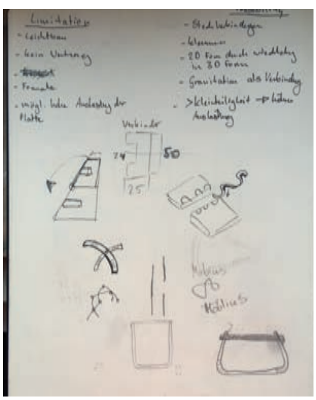
Sketches

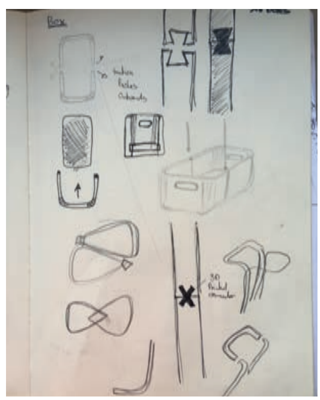




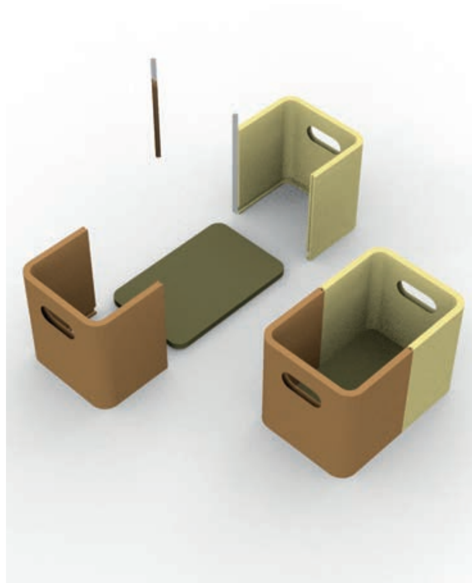








Ideas Rendered



three corners

Michelle Saß
Louis Wahlich
Jeremy Schlegel

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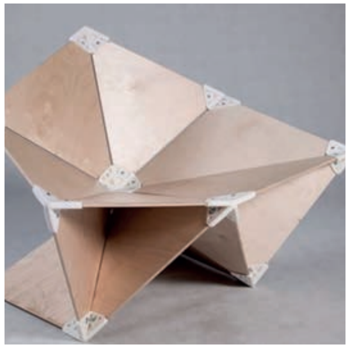
Reference I



Reference II

Reference III

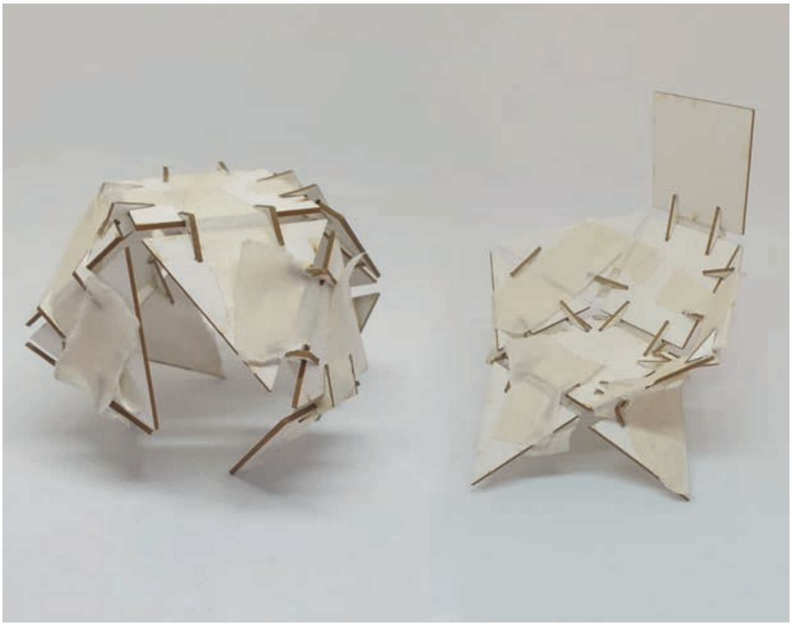
Idea and Concept

This semester we worked together with the company **16boxes** and Sebastian Felix Ernst on the short project **The Aesthetics of Efficiency** under the supervision of Prof. Dr. Manuel Kretzer.

16boxes is a Berlin-based company with the goal of creating sustainable furniture that is easy to build by simply connecting parts made of plywood. This collaboration aimed to achieve even greater sustainability by reusing the parts left over from the production of their shelves. So our goal was to create something new from this „waste“ so that not so much has to be thrown away.

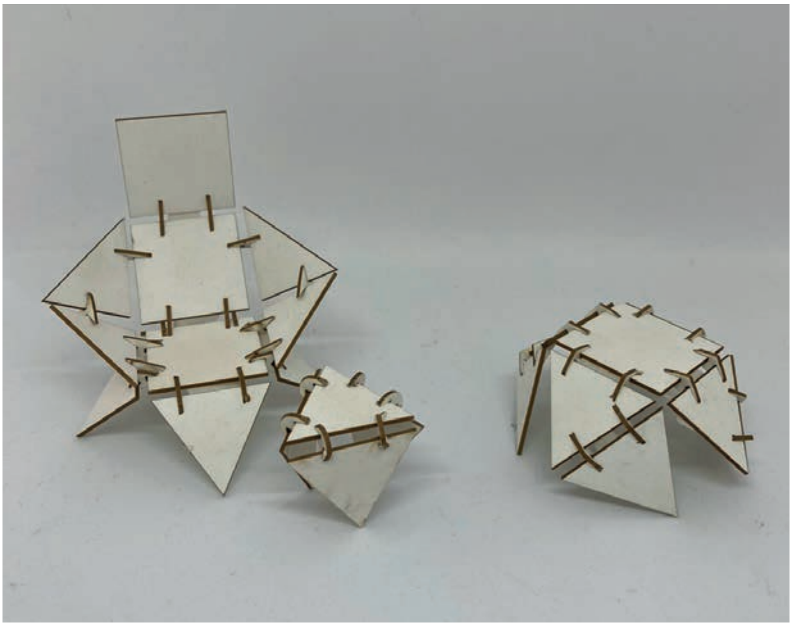
Our process focused on the material. First we had to understand what is possible with the plywood and what are the limits of what we can do with it. We knew that we were limited by the size of the wooden boards, but also by the fact that we had to keep additional parts to a minimum. One of the goals we set ourselves was to find a shape that was simple and made maximum use of the available surfaces. Our idea was also to give users the opportunity to expand their product when needed.

Experiment I



A modular system seemed to be a good approach to achieve our goal. After we had decided on such a system, we started to deal more with geometric shapes that we wanted to use for our product. The triangle quickly came to mind, as it is not that often used in furniture, but still a very simple shape. The regularity of the triangle is perfect to make the best use of the remaining wooden boards. To achieve even more efficiency, we focused on equilateral triangles, because no matter in which direction you turn them, the sides always fit together. In this way it opens up even more possibilities for designing different furniture and constructions.

Experiment II



We had decided on the shape, but there was still the question of how the different triangles could be connected. It was clear that we had to create a connecting piece that could be used in several directions. After trying out many different variations, we found out what worked well and optimized the parts accordingly. The result of this process were three different connecting parts.

1:1

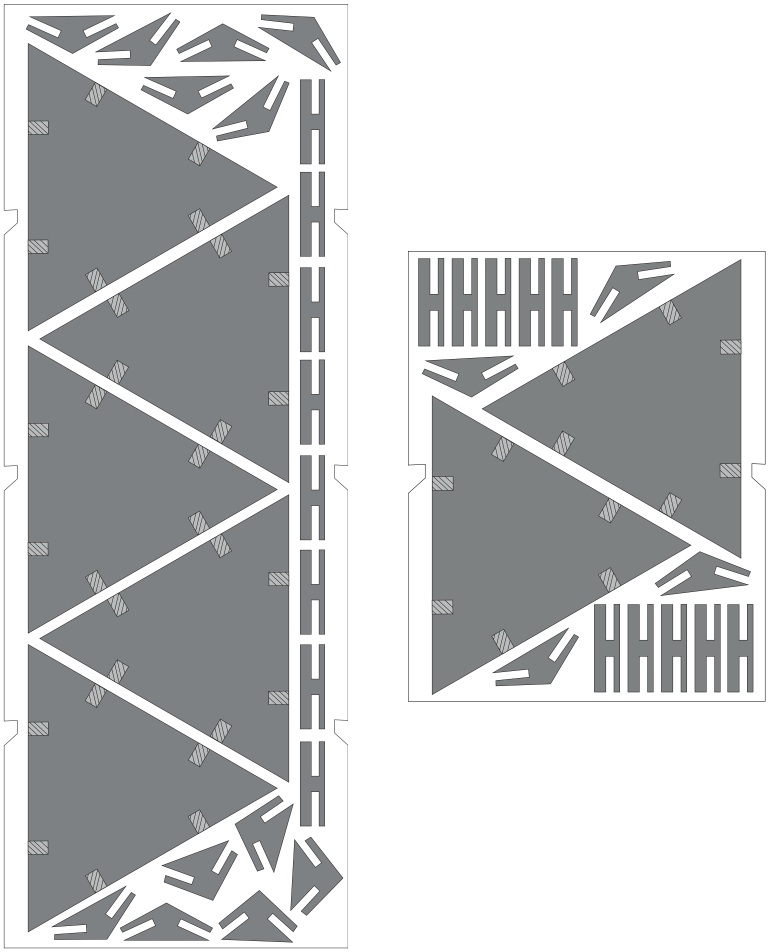
Our final product is a coffee table with three types of connectors. It consists of twelve equilateral triangles with six milled notches, twelve straight, eight 130 degree and four 100 degree connectors. The height is 24.4 cm and the width 60 cm. The connectors fit perfectly into the notches, creating an even surface.

Close Up I

Close Up II

Close Up III

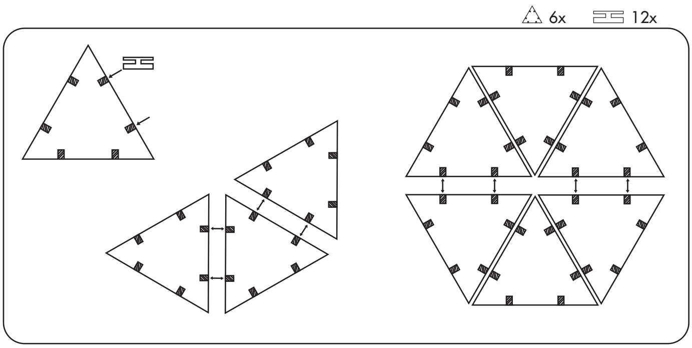
Cutting Layout & Production



The connector system was first tested using a laser cutter to create mockups. Based on these mockups we went to the wood workshop and built all parts by hand. For a larger scale production the parts can be cut out with a CNC milling machine.

Assembly

1



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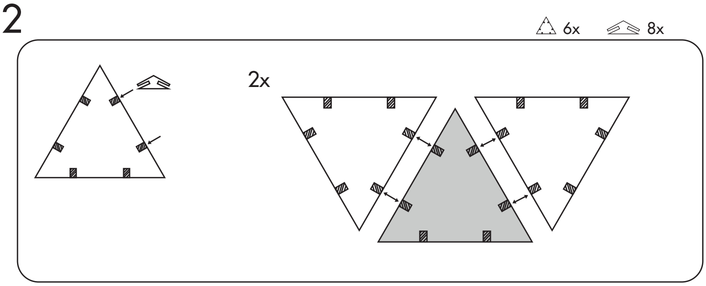

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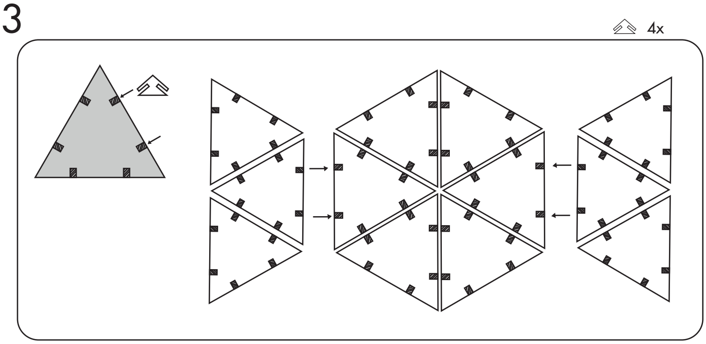
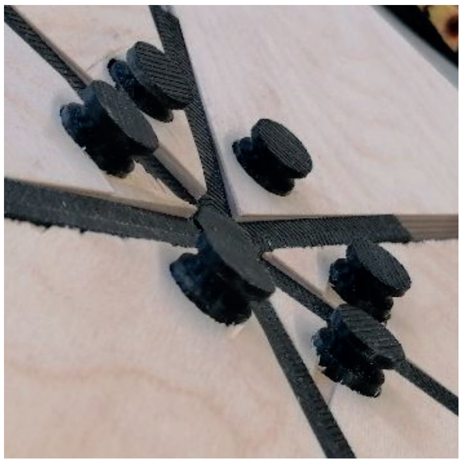


Details

Our final product **three corners** is expandable. More triangles can be added to create different furniture.

Okta Chair



Felix Koppe
Lena Brake

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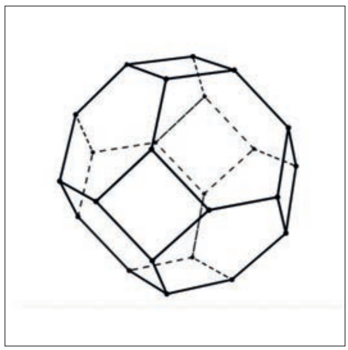
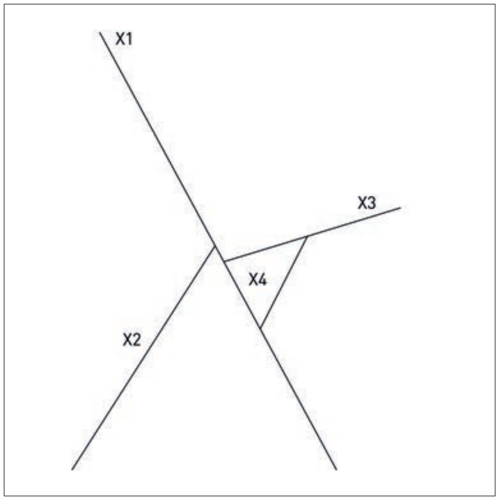


Reference III

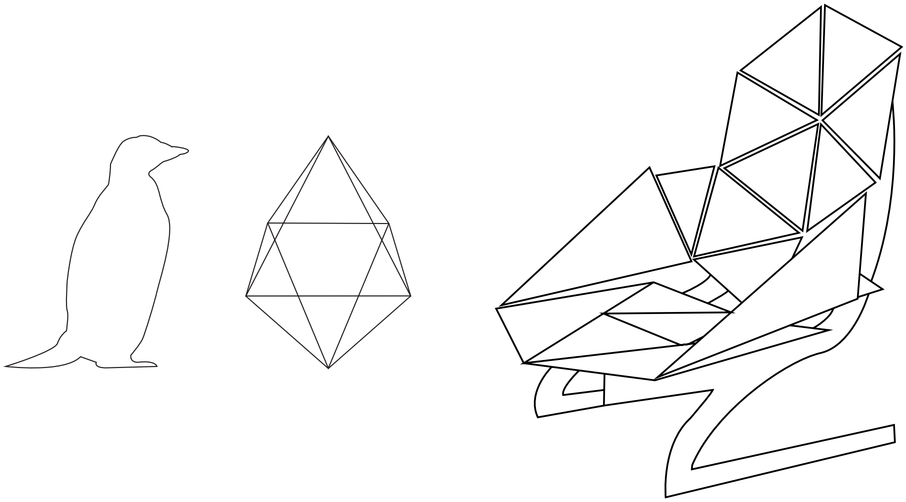
Idea

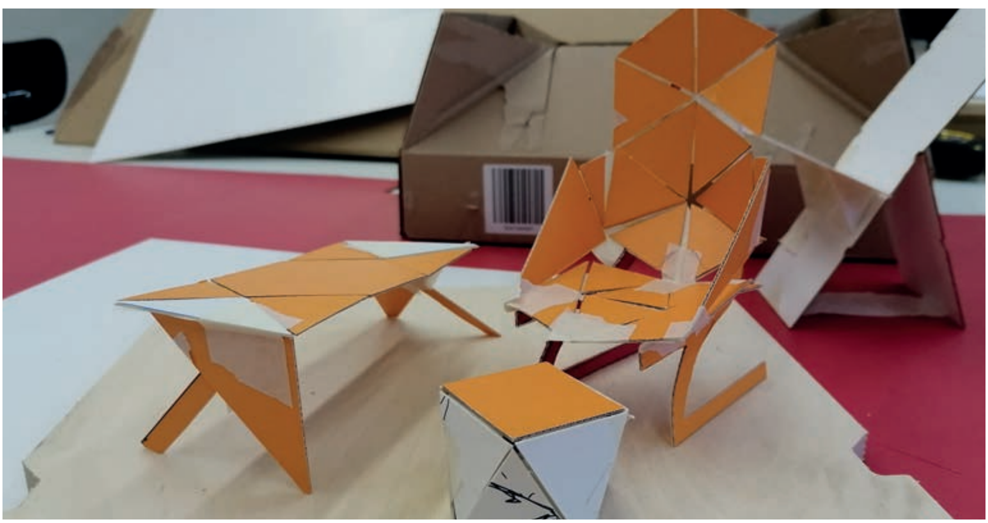
The goal of our design was to create a plug-in chair for which as much as possible of the excess material of **16boxes** is used. The individual elements (equilateral triangles, hexagons, right-angled triangles) are removed from the remaining material using a CNC milling machine. They are joined by 3D-printed connectors, which derive forces (tensile force, compressive force and torsional force) constructively. A tongue and groove connection system is used so that all parts can be easily joined together.

Experiment I



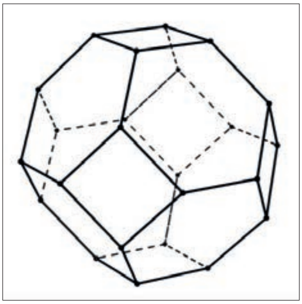
Experiment II

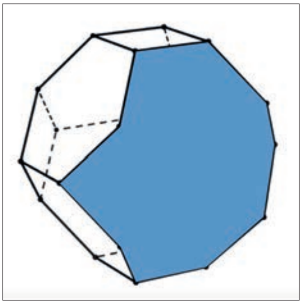


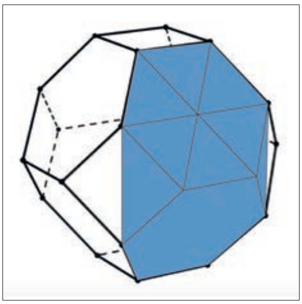


An experiment with geometric figures, combined with the anatomy of penguins, with the aim of constructing a chair.

Experiment III

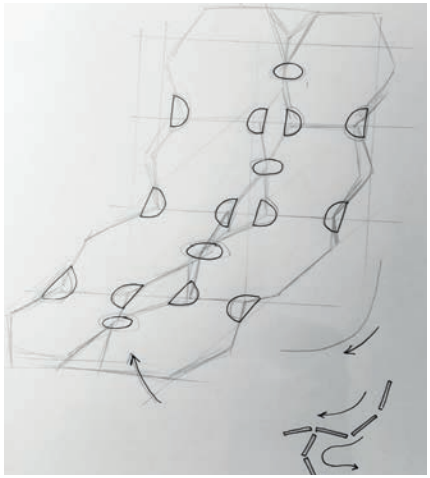


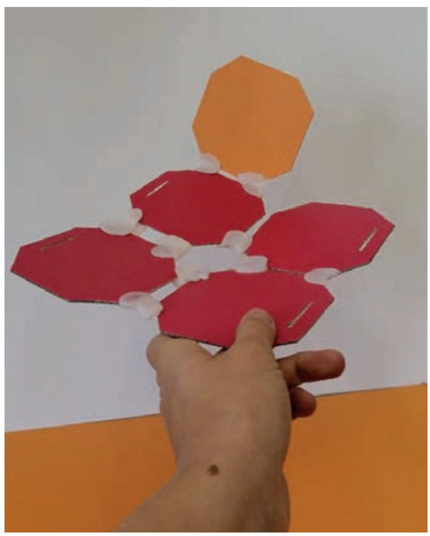




We wanted to use the shape of a hexahedron stump to design the shell of a chair.

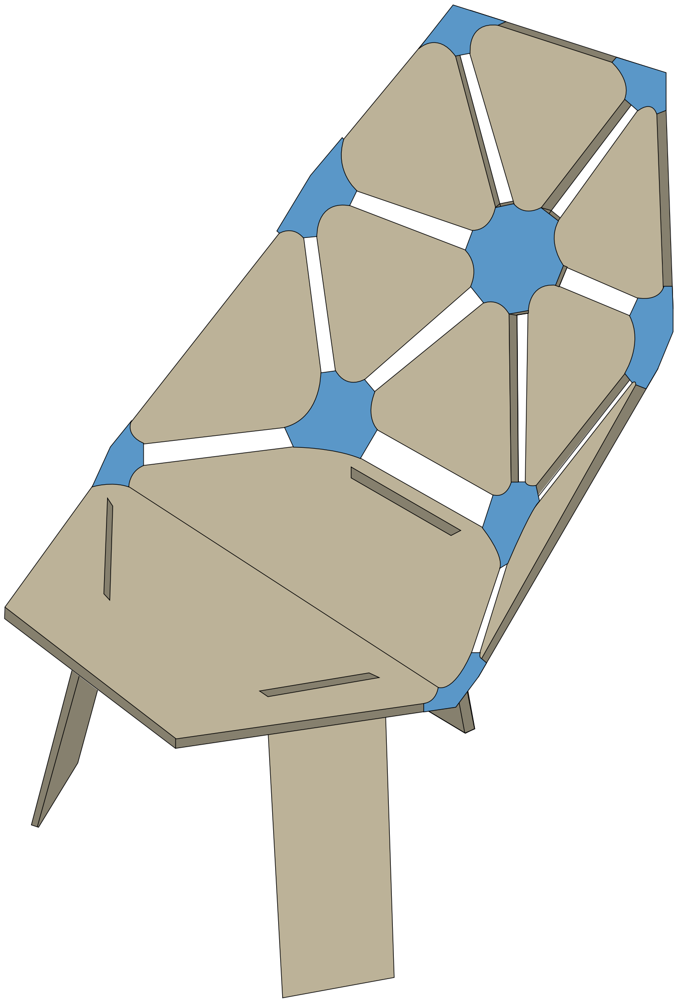
Experiment IV





In this approach, we tried to construct a chair using only rectangles.

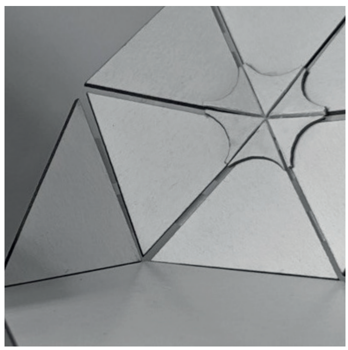
1 : 1



Okta Chair – A pluggable chair held together by 3d-printed connectors.

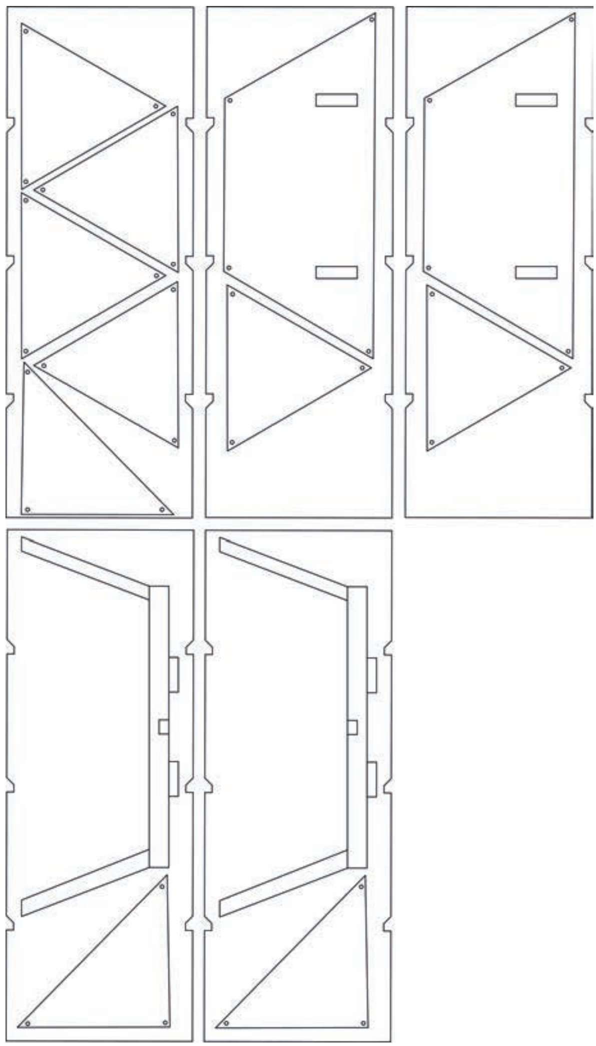
Close Up 1:10 I

Close Up 1:10 II

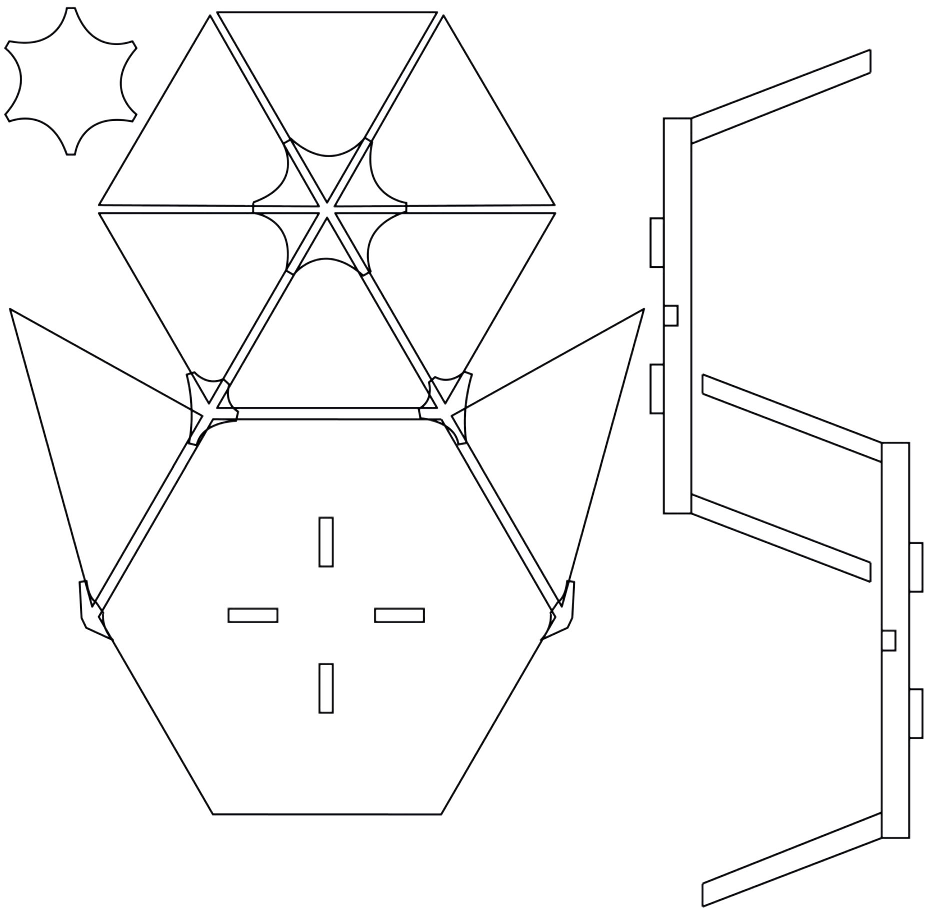


Close Up 1:10 III

Cutting Layout

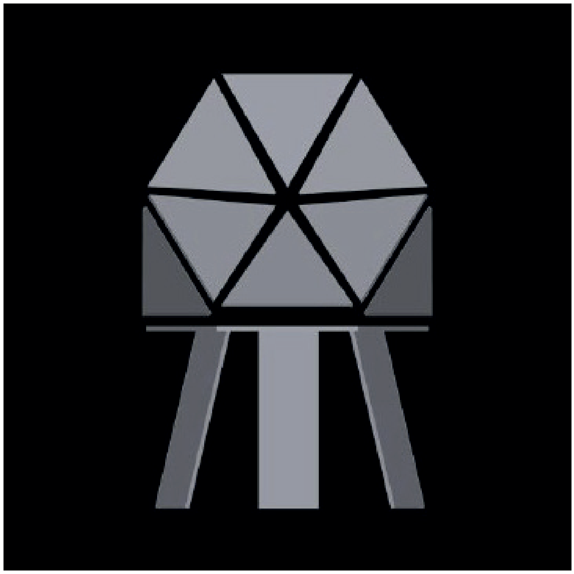


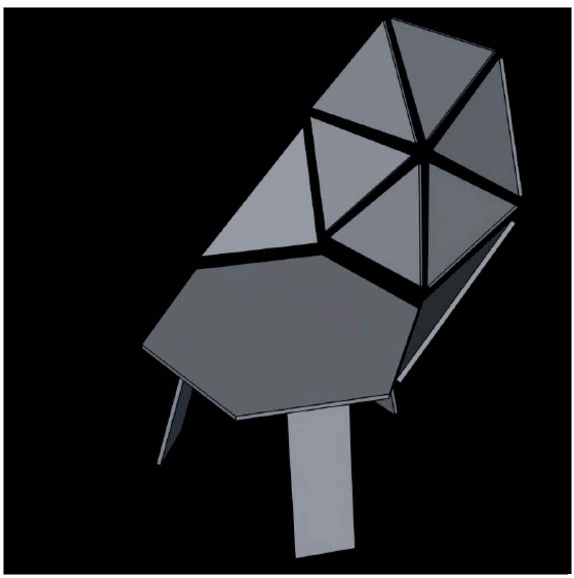
Assembly & Production

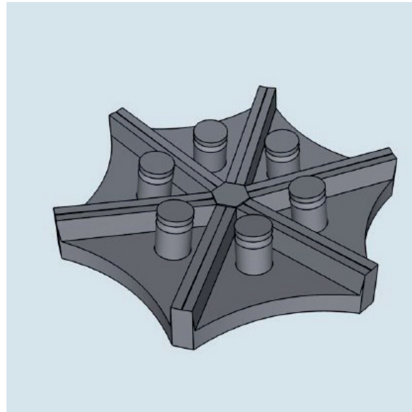
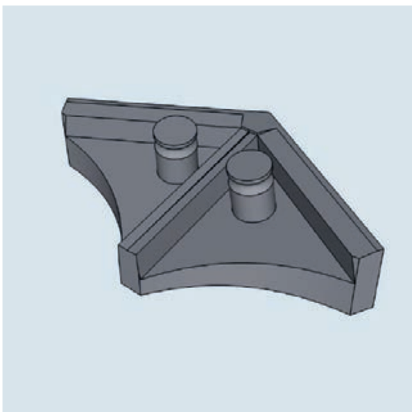
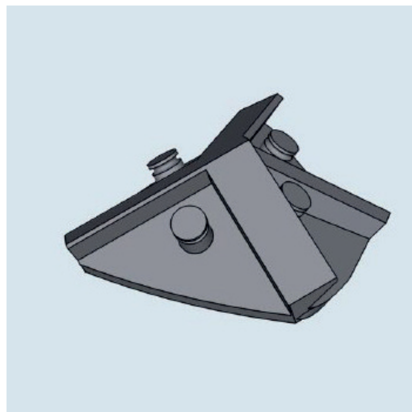


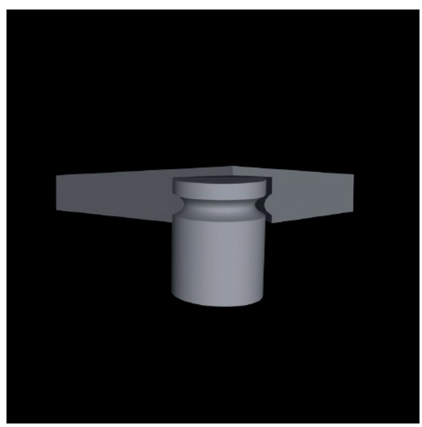
The individual plywood segments of the **Okta Chair** are manufactured by CNC milling and the connectors are made through 3D printing.

Details





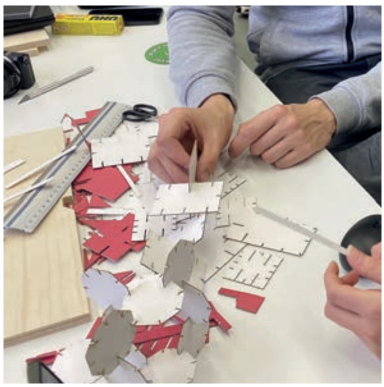







The Making-of


Die (beinah) Form
Nestle Bp


Unser Ansatz ist es das Material
ohne auf Funktion, Stabilität und Größe
Der Benutzer soll ein spielerisches Erlebnis mit
seine räumlichen
B




three corners
B

Vitas

Prof. Dr. sc. Manuel Kretzer is professor for Material and Technology at the Dessau Department of Design, Anhalt University of Applied Sciences. His research aims at the creation of dynamic and adaptive objects with a specific focus on new smart and biological material performance and their combination with advanced digital design and fabrication tools.

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Nils Wadt is CEO and designer at 16boxes. He came to furniture design by turning a local problem (how to live mobile, flexible and sustainable) into a product for those with the same perspective. Having studied philosophy, sociology and german studies, the entry to design is based on concepts of modernity and a strong focus on user experience.

www.16-boxes.com
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Stefan Bruning is lea product designer at Ono Bikes. Having worked in a variety of contexts, his focus lies on navigating the journey from prototype to serial production.

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Sebastian Felix Ernst, architect and designer, experiments with low and high tech processes to develop prototypes and experimental spatial setups. He co-tutored the physical and methodical paths to formulate new approaches in this workshop.

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Christian Smirnow is service designer with a background in transdisciplinary design (Parsons New School) and has been teaching design thinking as a program lead at HPI, promoting collaborative innovation projects from students.

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