ONDELLE

3D VENEER COFFEE TABLE

STRUCTURE

MATERIAL BASED DESIGN

– Prof. Karen Donndorf I Volker Mahn

DEFINITION

Material-based design focuses on selecting and utilizing materials as the primary factor in shaping a product's form, function, and performance. It emphasizes the intrinsic properties of materials—such as strength, flexibility, conductivity, and aesthetics. The goal is to create solutions that leverage material capabilities for sustainability, durability, and usability.

PROJECT

In the first step, we selected a material and a manufacturing process from three available options.

The design could be mono-material, or an additional material and manufacturing process could be incorporated as the design evolved.

The primary material chosen defined the main form-giving and characteristic aspects of the design. Each course participant designed their own small piece of furniture using the selected material and process.

Metal semi-finished products

- Metal sheet - water jet cutting, punching, folding, bending, pressing, deep drawing, joining
- Metal tube - cutting, bending, joining
- Metal round profile - cut, bending, joining

Wood - from flat material to the product

- Plywood 2D - forming, cutting
- Plywood 3D - forming, cutting
- Wood panels - cutting, joining, milling

Plastic

- Injection moulding (simulation by 3D printing or model)
- Rotational moulding (simulation using 3D printing or model)
- Vacuum forming

3D VENEER

is engineered to be flexible, allowing it to be molded into complex, three-dimensional shapes. This flexibility of 3D veneer enables innovative designs and applications that are not possible with standard 2D veneer.

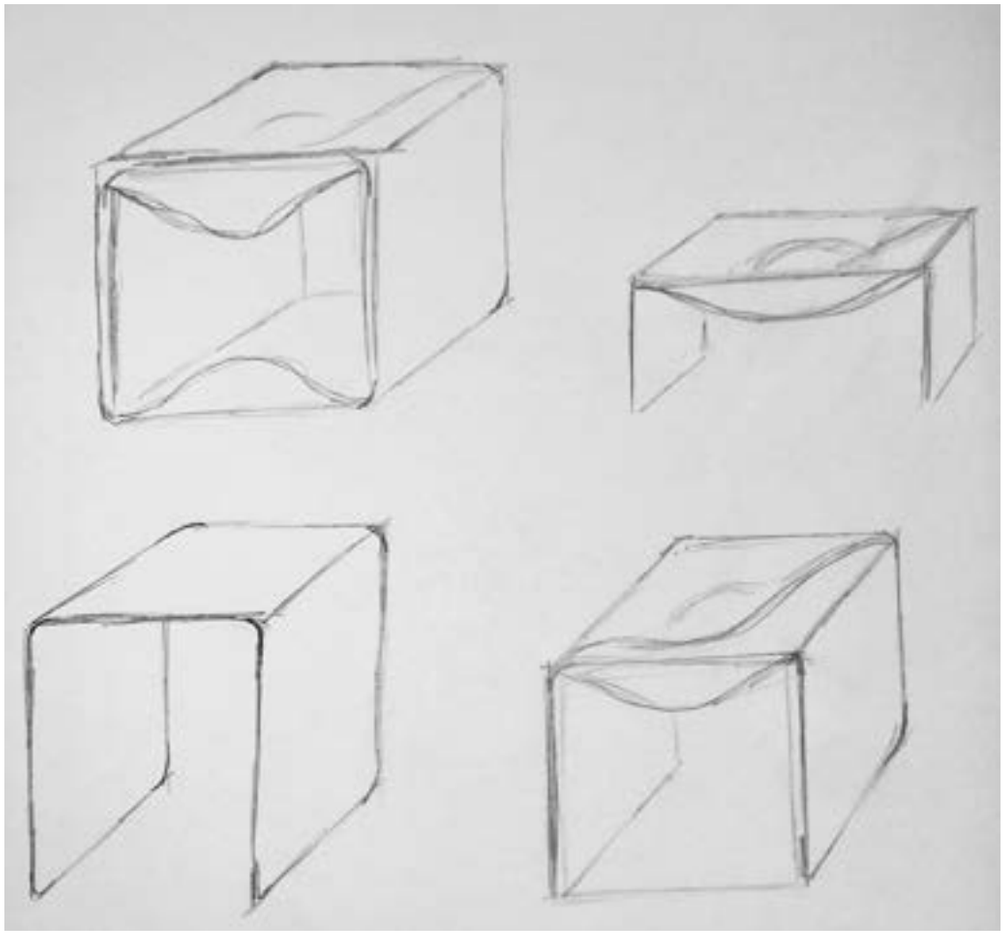
The 3D veneer from Danzer offers a high-quality material that conveys exclusivity and is light and stable at the same time. This makes it ideal for furniture, interior design or decorative applications. As a sustainable and economical alternative to solid wood, it enables similar aesthetic effects with lower material consumption.

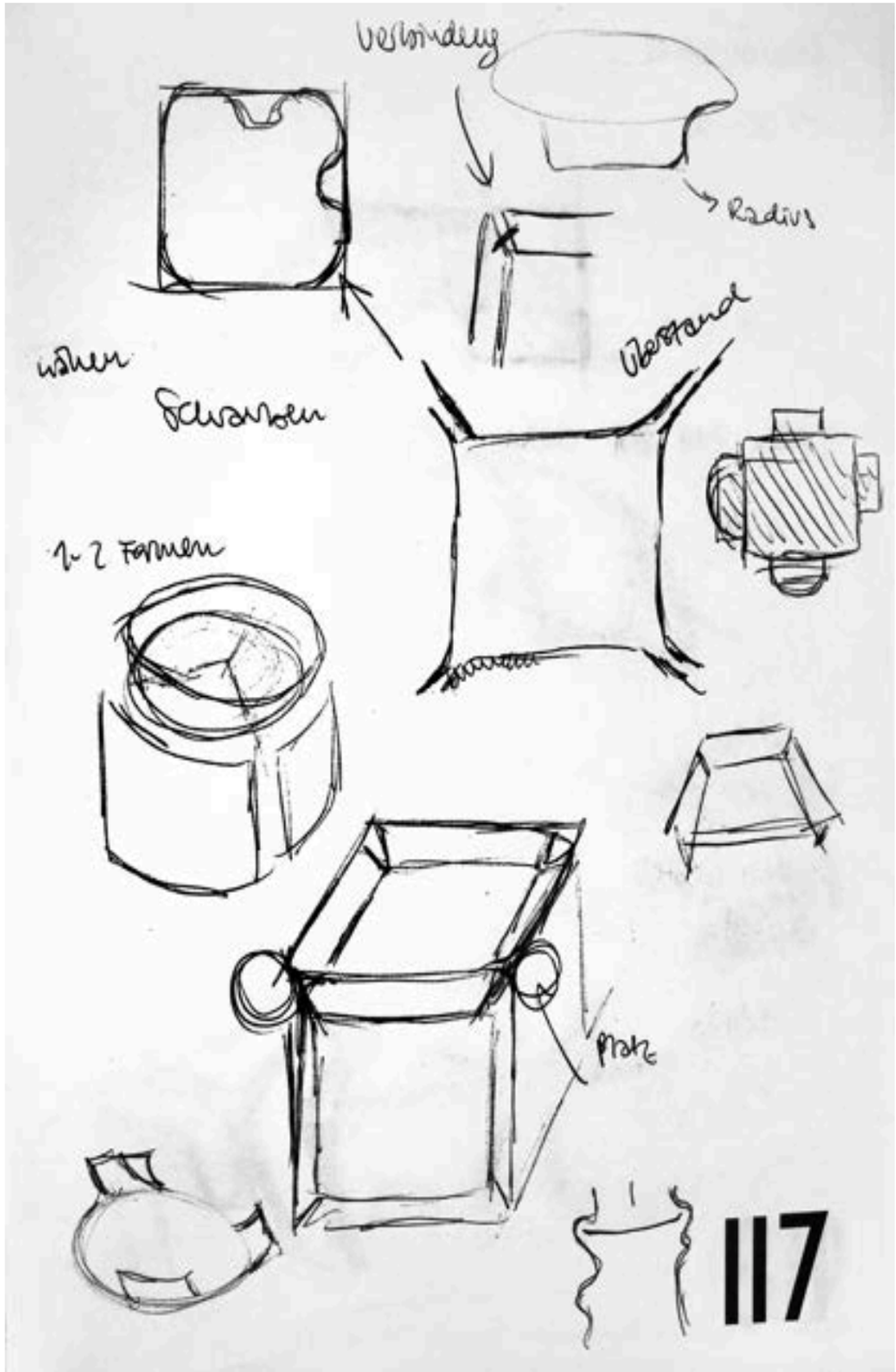
INSPIRATION

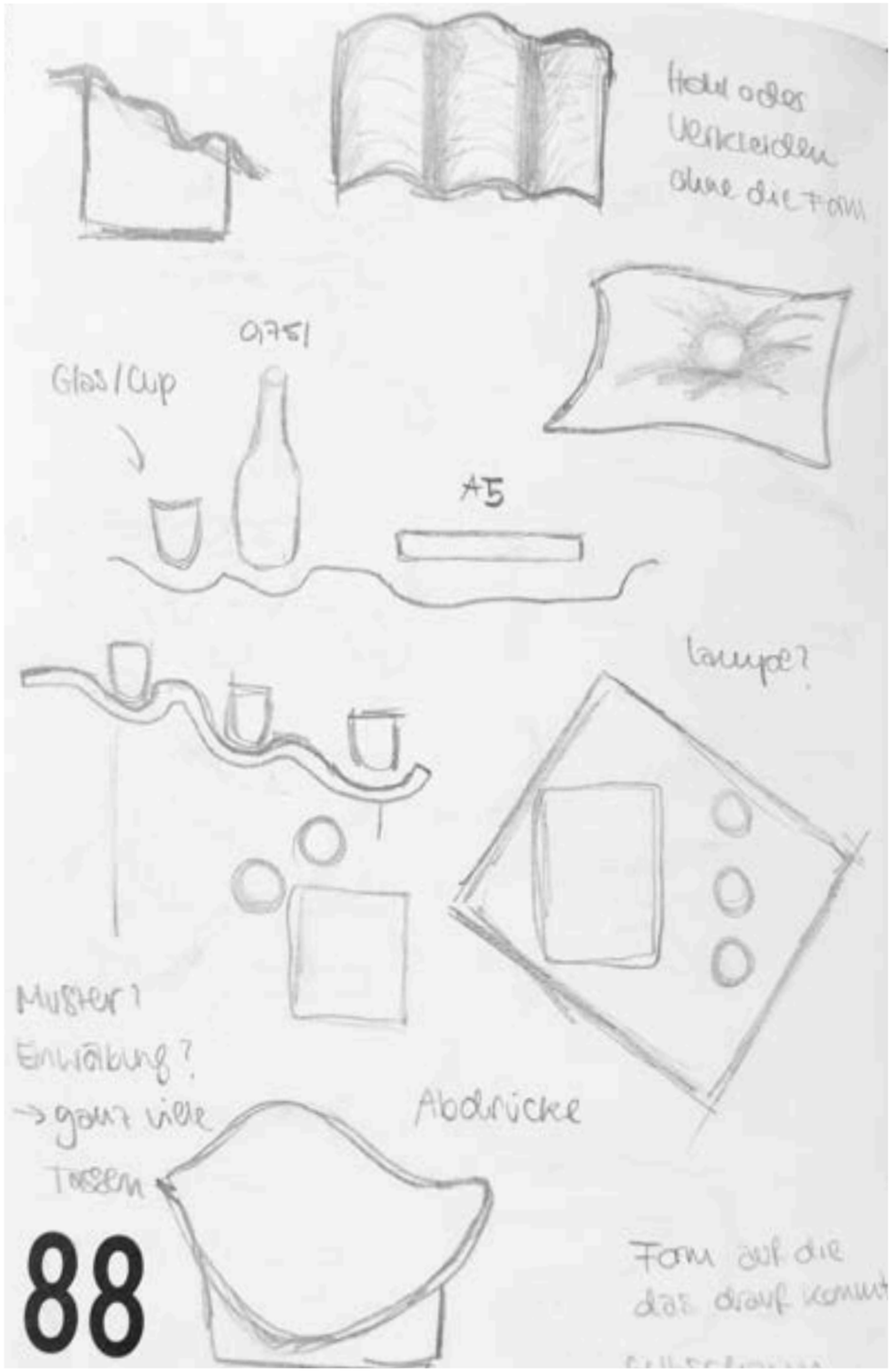
PINTEREST

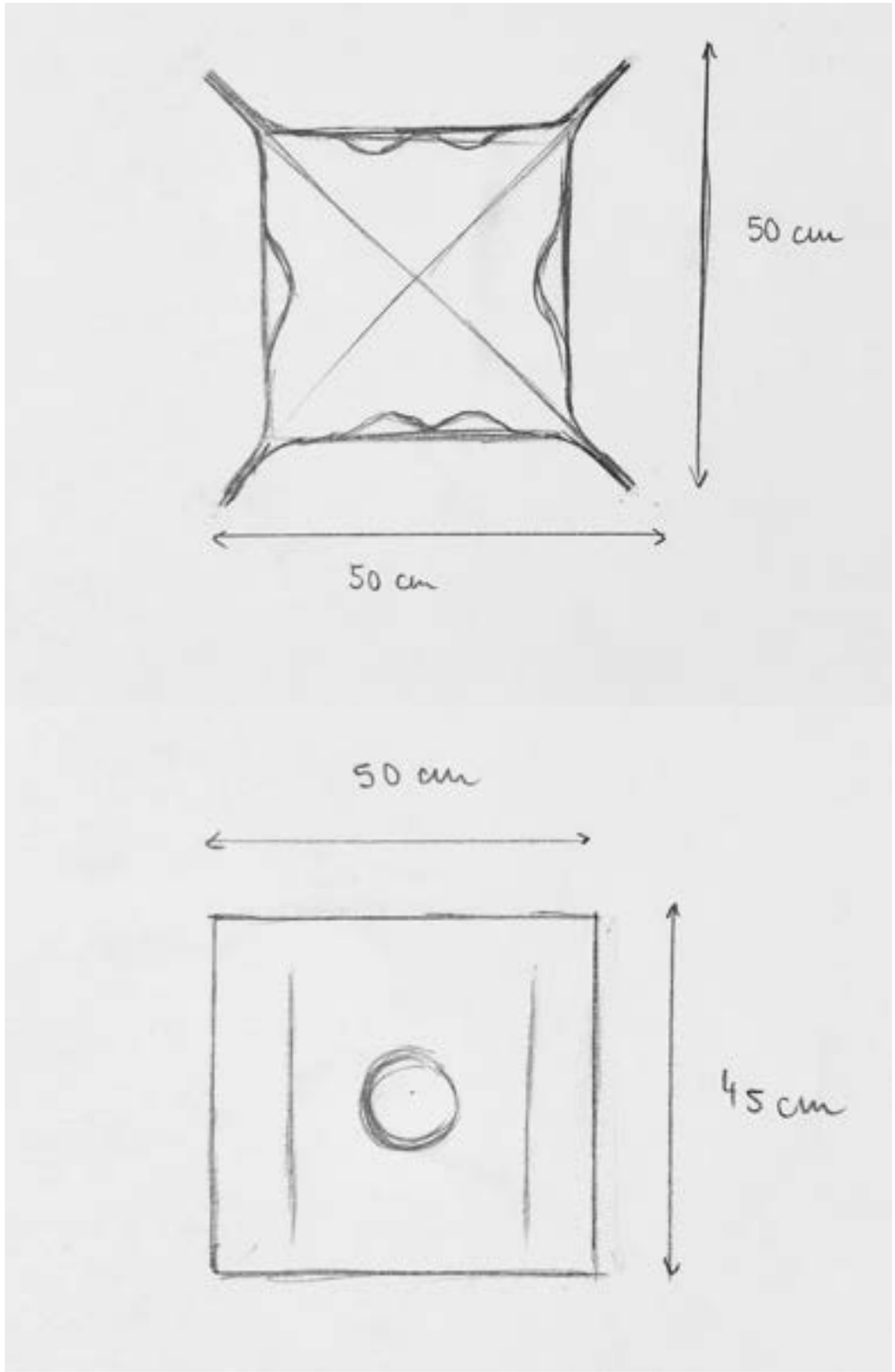
SKETCHES

help to visualize design ideas and o try out different ideas. However, double-curved surfaces are difficult to accurately represent on paper, making it challenging to capture their complexity. Therefore, it is essential to build quick models early in the design process to better understand proportions, form, and spatial relationships. The design should deliberately emphasize the natural wood grain





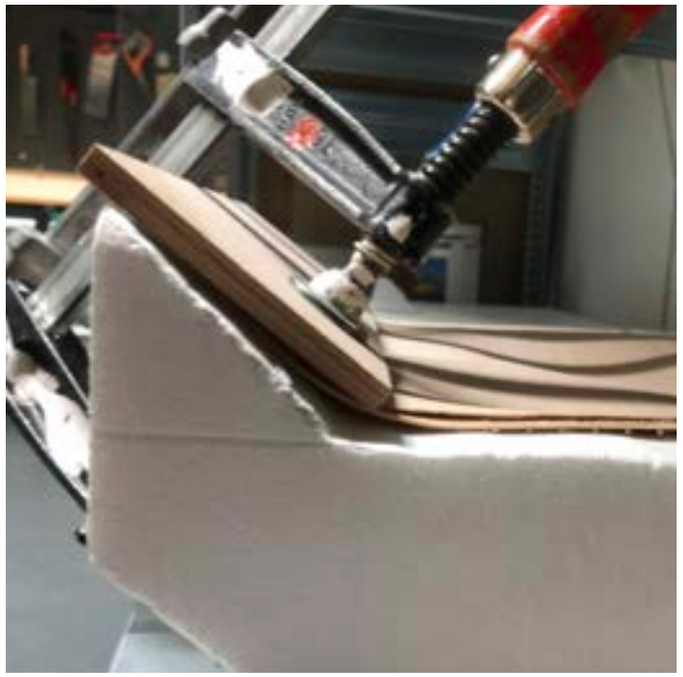

Glas / Cup
0,75l
A5
Lampe?
Muster?
Einfärbung?
→ ganz viele
Tassen
Abdrücke
Form auf die
das drauf kommt


50 cm
50 cm
50 cm
45 cm

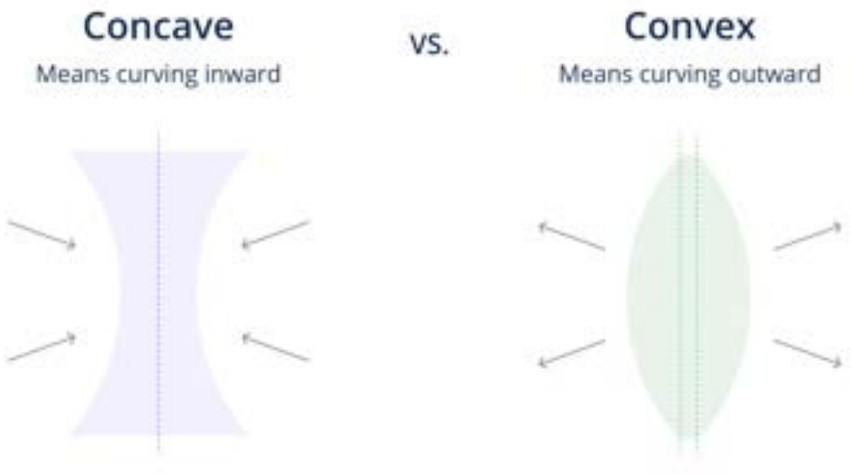
BUILDING THE MODEL

PRESSING

Vacuum technology is used to press 3D veneers onto curved or complex surfaces. The concave form is creating uniform pressure across the veneer. It ensures that the veneer conforms perfectly to the desired shape. The form stays in this pressure for 3h . Afterwards the mold is re-tensioned.



PRESSING FORM



Quillbot

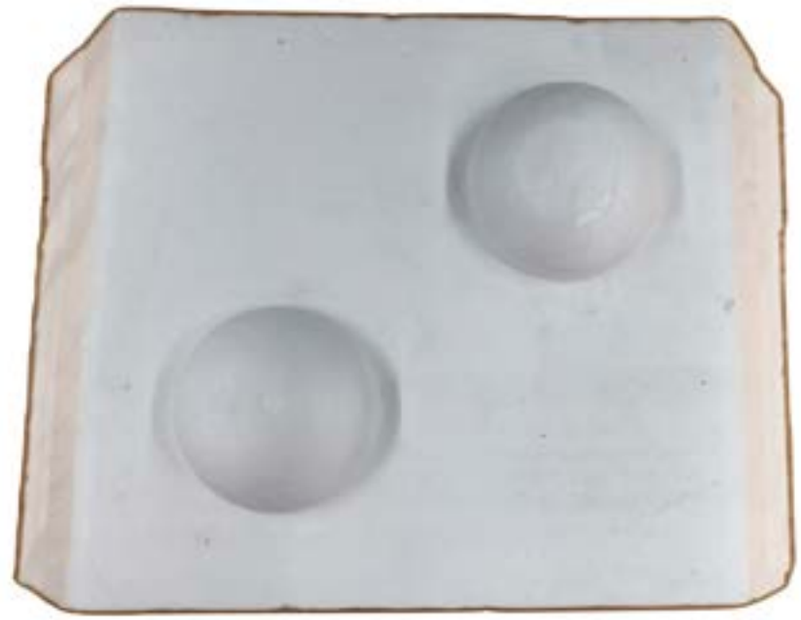
Advantages of a convex mold

The vacuum pressure allows for easier stretching, ensuring the material lays evenly over convex surfaces. The uniform tension minimizes wrinkling. Additionally, it is easy to demold from the foam mold.

Advantages of a concave mold

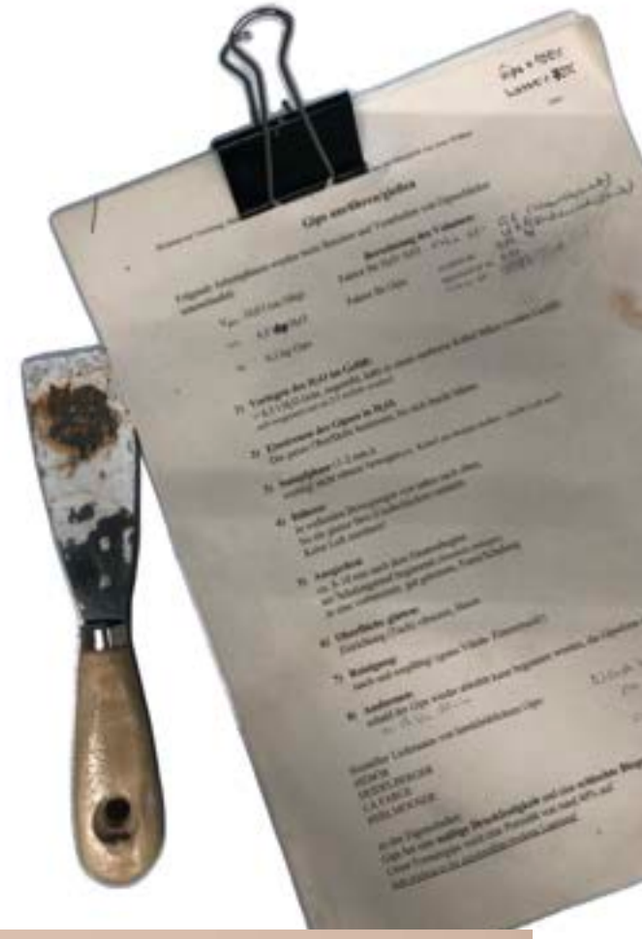
It prevents overstretching, as the material is pulled into the cavities without being strained. Vacuum pressure enables exact detail embossing by pressing precise contours deep into the recesses.

In conclusion, a convex mold is better suited for vacuum technology because it prevents wrinkling. The vacuum pressure ensures the material stretches evenly over the surface, maintaining uniform tension.



PLASTERS

The inner molds are made of plaster in two different sizes. Plaster is ideal for vacuum forming as it is easy to shape and provides a smooth surface. It is suitable for making molds with precise contours and textures and is durable enough to withstand repeated molding cycles.



PLASTIC FILM

The Plastic film is not ideal for vacuum technology as it tears easily under pressure, compromising the vacuum seal. Additionally, using double foil increases complexity during handling, making the process less efficient and more prone to errors.

FOAM FORM

A foam form combined with small plaster forms is excellent for vacuum technology because the foam provides a stable, plain surface that ensures uniform pressure distribution. The small plaster forms shape the veneer's surface precisely. Since the two forms are not connected, the surface design can be rearranged flexibly, enabling versatile and customizable production without creating new molds for each variation.

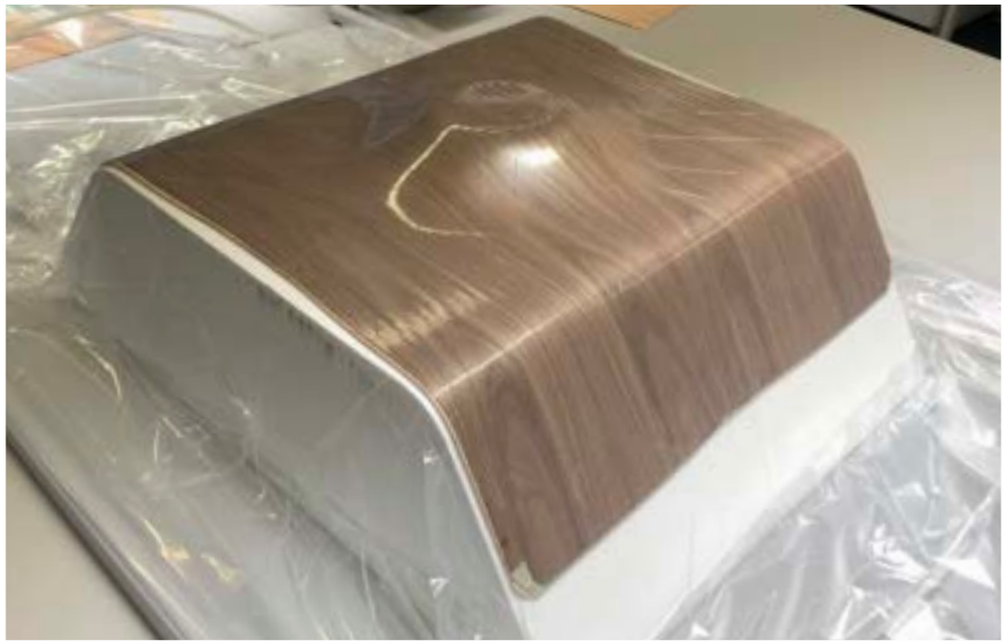
PREPROCESS

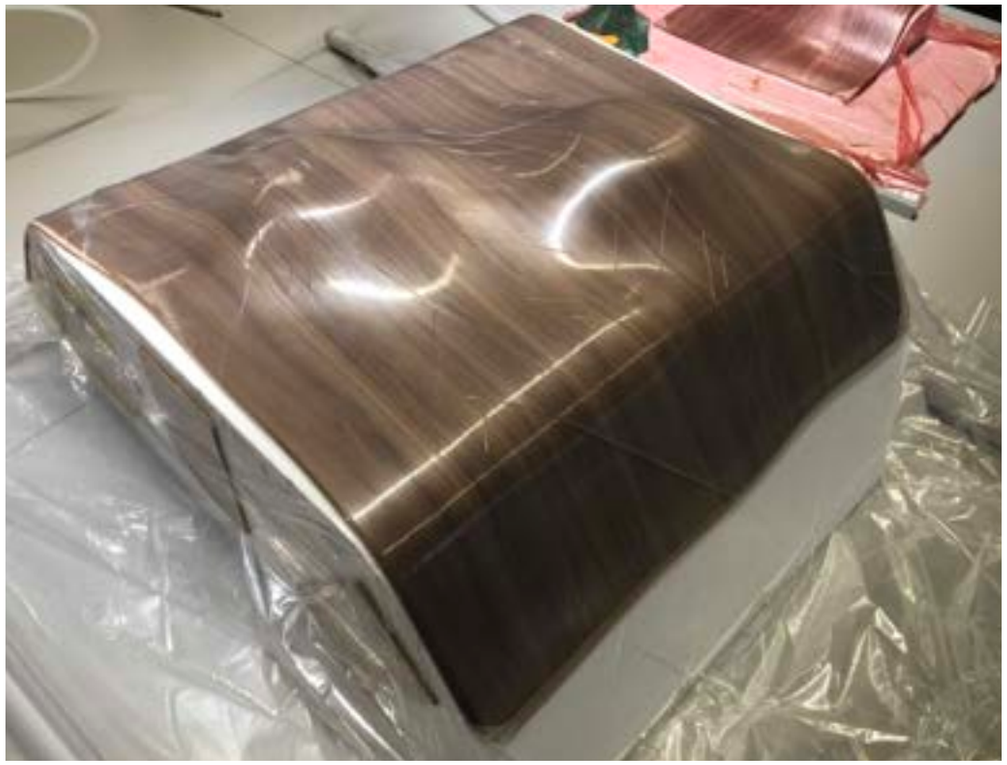
The 3D veneer layers can be cut to size with precision. Using guillotine shears ensures the veneer is shaped exactly to the desired measurements, offering accuracy and efficiency.

The four layers of veneer are coated with D4 wood glue and pressed onto a foam mold under vacuum pressure.

PRESSING

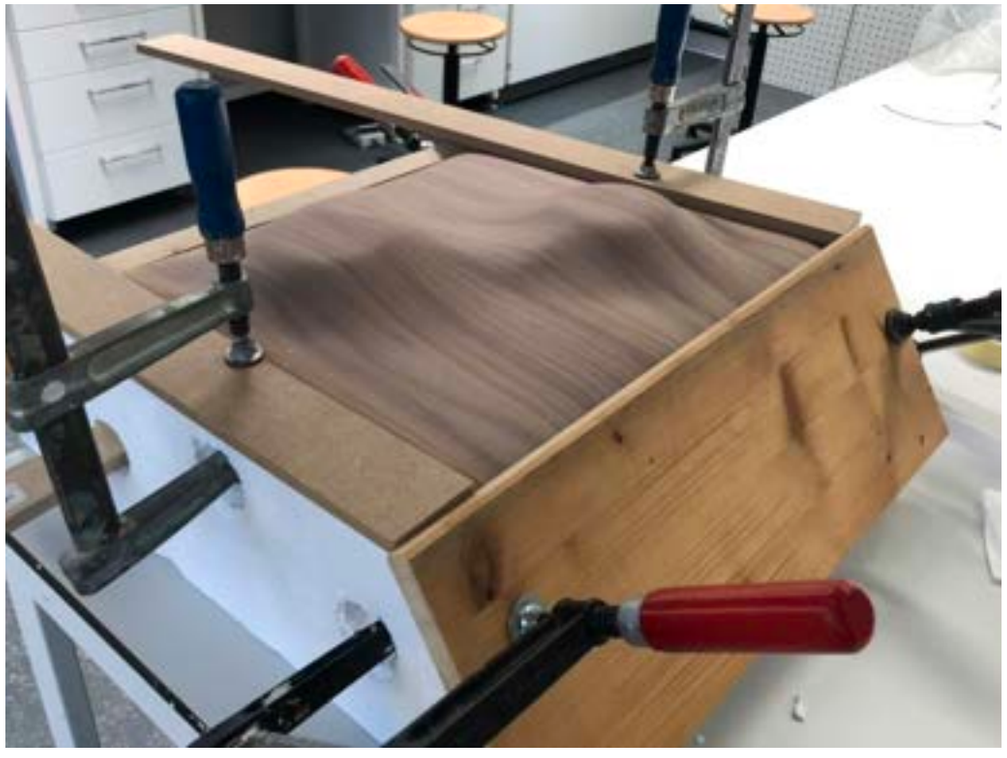
The veneer sheets conform precisely to the mold under vacuum pressure. They are held in this position for three hours. This ensures the veneer retains its shape and forms a strong, consistent bond.





RETENSION

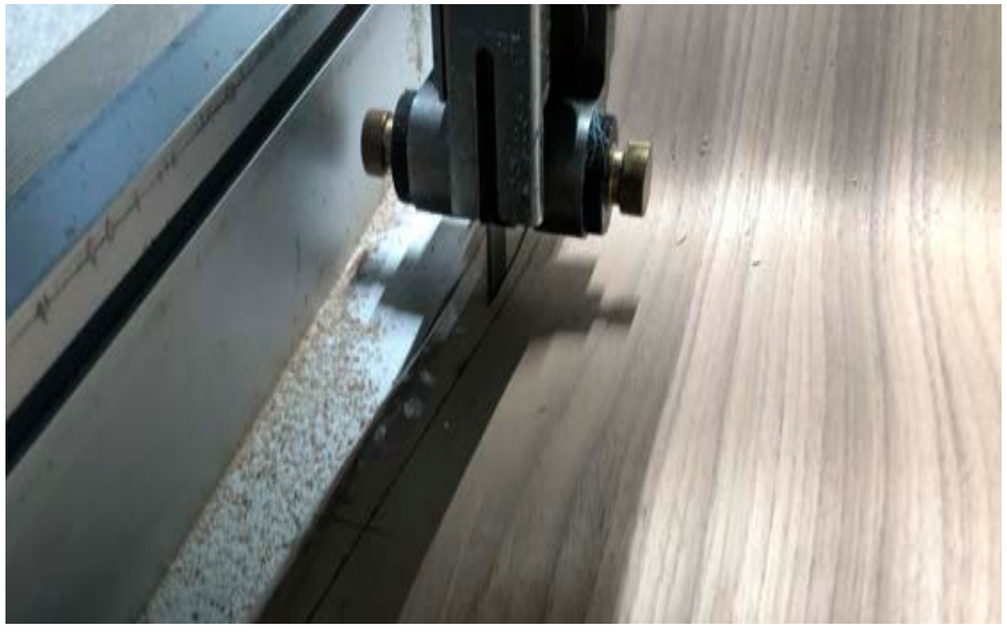
The sheets of veneer are retained using clamps and wooden braces to hold them firmly in place while the glue dries. This method ensures that the sheets maintain their intended shape and do not shift or warp during the drying process. The even distribution of pressure provided by the clamps is critical for achieving a strong and uniform bond between the layers. This retention process is essential for ensuring the final structure's stability, durability, and precise fit.

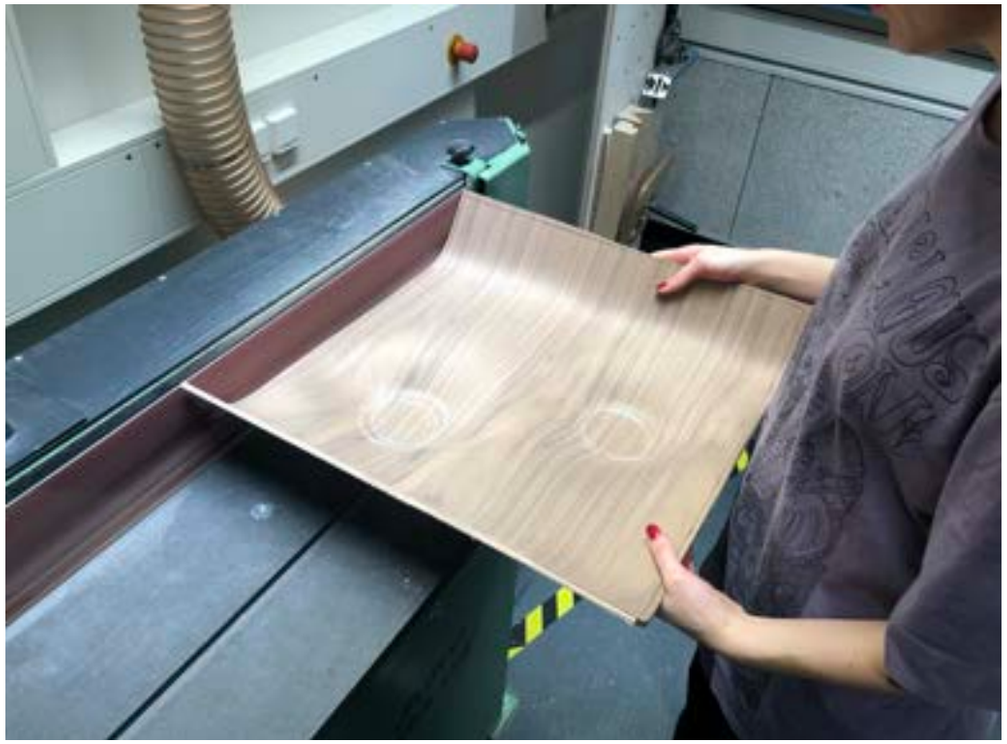


SAWING

Placing a paper template on the pressed veneer helps to precisely outline and measure the desired angles and dimensions. This ensures accuracy in cutting and aligning the veneer, maintaining consistency with the design specifications.

The veneer panels are precisely sawn to ensure they all have the same dimensions. This step guarantees consistency and uniformity in the final application.



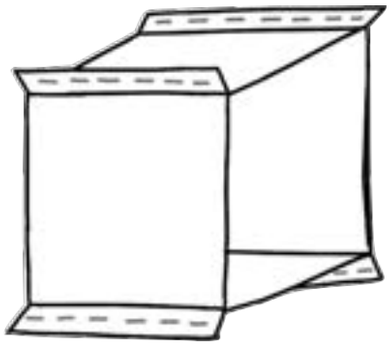


DUSTING

The veneer panels are carefully sanded twice to achieve a smooth finish. First, they are sanded with 120-grit sandpaper, then lightly moistened to raise the wood fibers, and finally sanded again with 240-grit sandpaper for a refined, even surface.

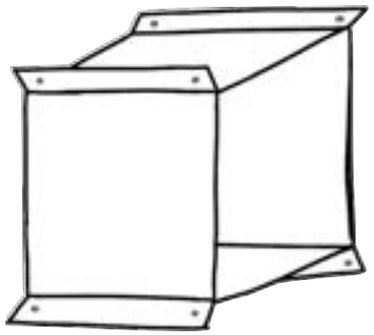
CONNECT

Another crucial factor in the realization was the integration of connection points that should not compromise stability. Different connection methos are offering benefits in terms of permanence and flexibility. The best choice depends on factors like aesthetics and durability.



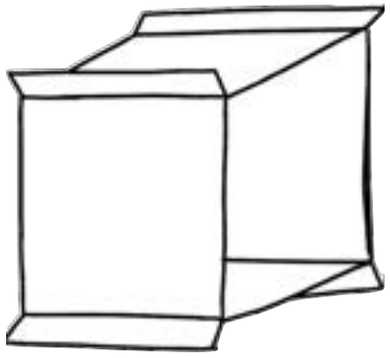
Sewing

offers functional and aesthetic benefits. It creates a strong bond and can be adjusted for tension and alignment. It has the ability to easily undo the seams for disassembly. However, stitching may not be practical for high-volume or professional applications where precision and durability are critical.



Using Bookbinding Screws

provide a secure and adjustable connection. They are easy to install and offer a strong bond. However, the visible hardware may not suit projects seeking a seamless or minimalist look. Drilling holes for the screws can weaken the veneer.

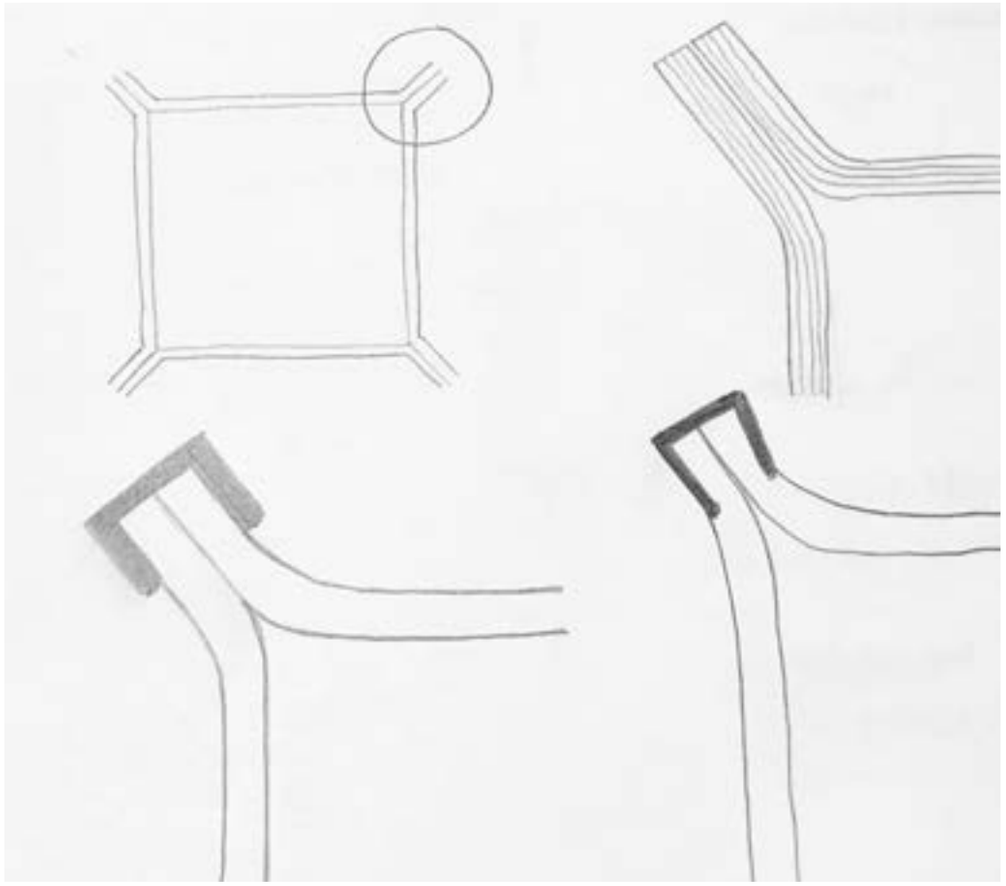


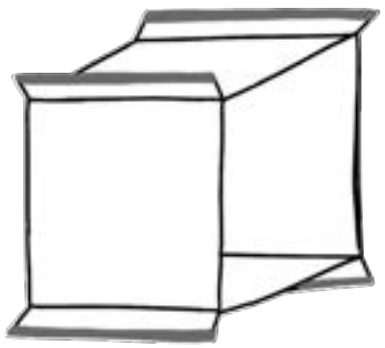
Gluing

creates a strong and seamless bond between surfaces. The invisible connection is ideal for ensuring a clean appearance without visible hardware. When applied properly, gluing can offer excellent long-term durability. However if the need arises for a detachable solution, gluing presents a significant disadvantage, as it creates a permanent bond.

CONNECT

Slightly conical U-profiles made of 0.8 mm stainless steel ensure a stable, detachable and form-fit connection. Stainless steel was chosen for its excellent durability and corrosion resistance.



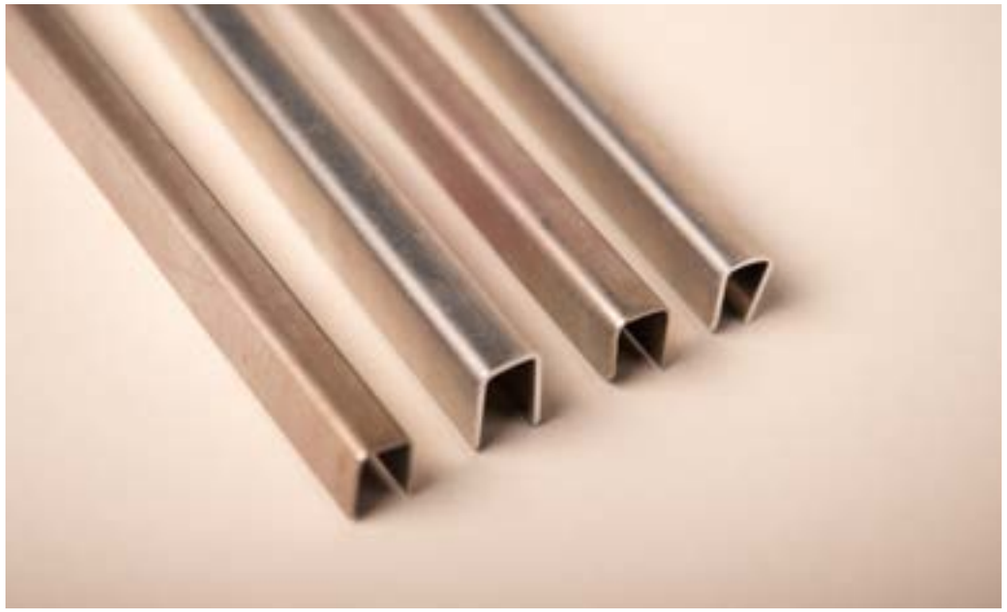


The detachable connection provides flexibility for assembly and disassembly, making maintenance and repairs more efficient and cost-effective. This combination of stainless steel and a removable design ensures both long-term reliability and adaptability to changing requirements.

OILING

The veneer was oiled with worktop oil in two separate applications to emphasize the wood grain and protect the surface. After each application, the excess oil was removed with a white cloth after 20 minutes.

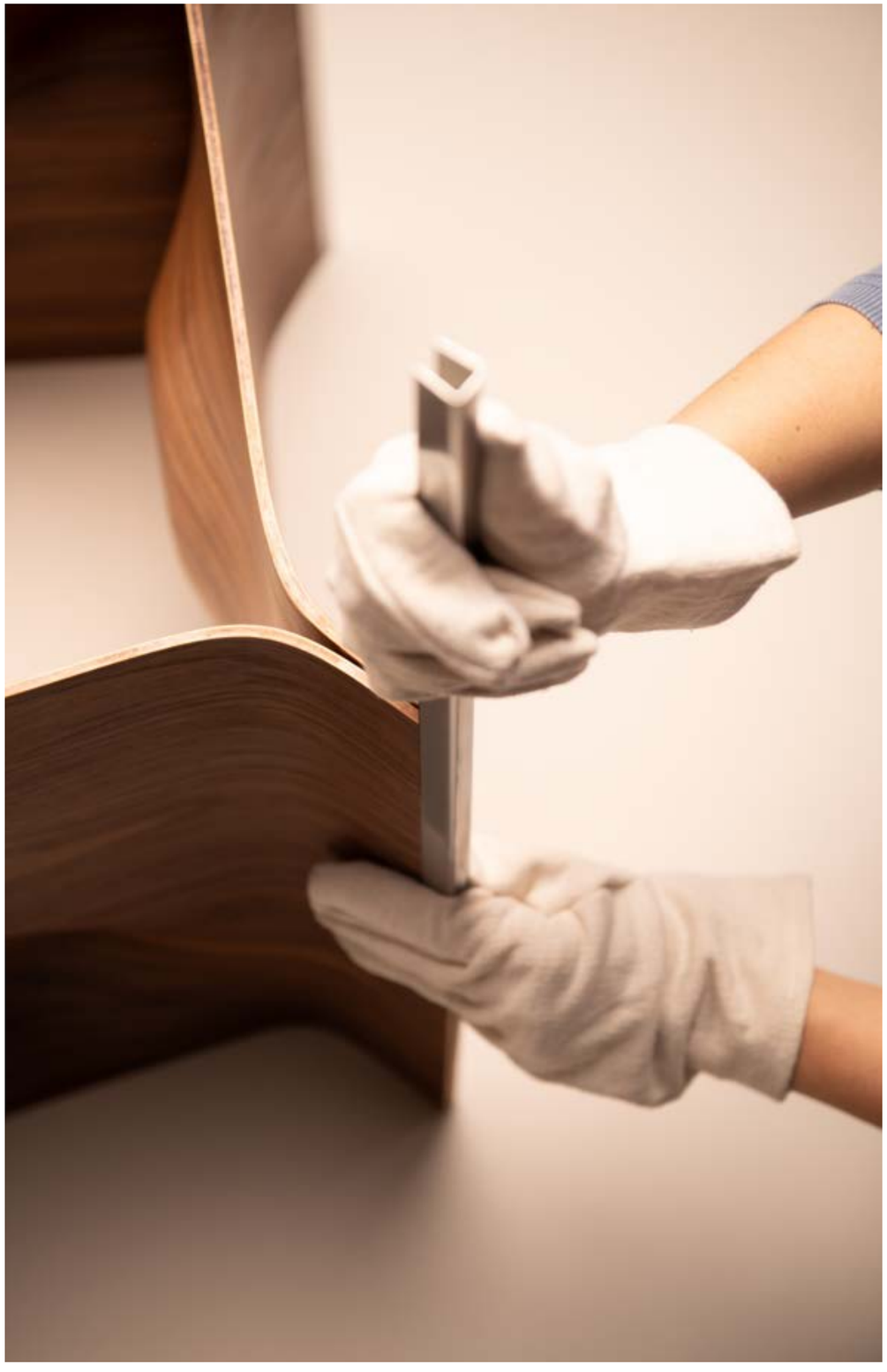
POLISHING

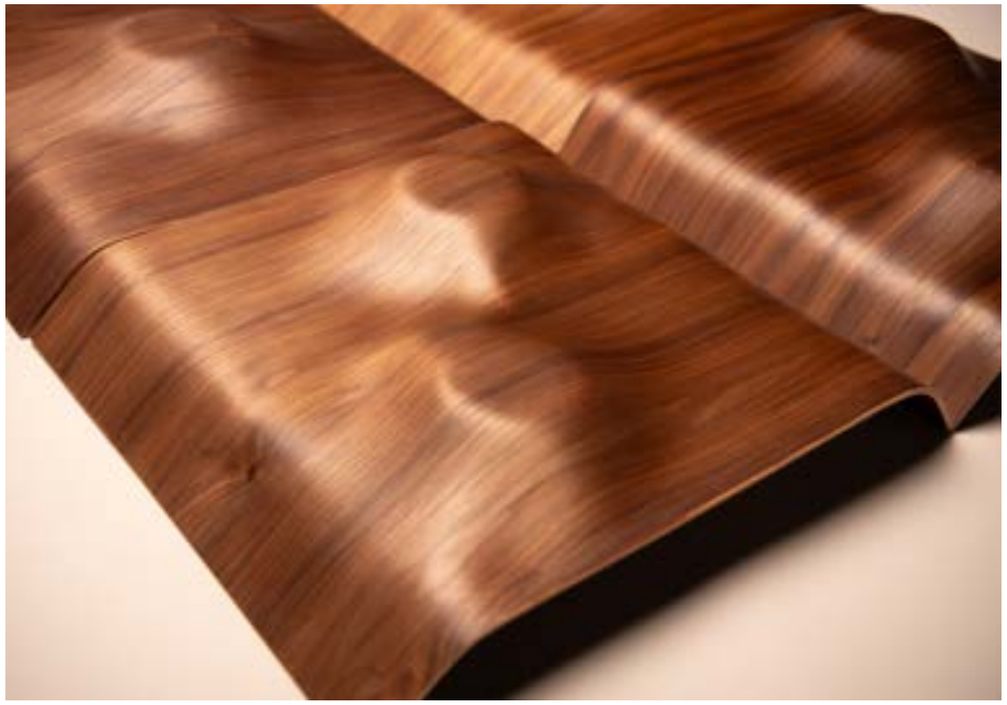


Different bend sizes were tested extensively to experiment with different angles to ensure the steel profiles were bent accurately. The bending machine had limited capabilities for bending at such a small distance that it was difficult to determine the exact profile length that could be bent.

SET UP

The modular design allows the user to have a table that adapts to the individual context of use. The table surface can be changed by rotating the object. It has detachable connections and can be packaged to save space. The combination of modular components makes the design practical and sustainable.





REFLECTION

form-giving factors

The flexibility and malleability of the 3D veneer enables the creation of flowing organic shapes. The design relies on the rigidity of the curved surfaces to ensure the necessary load-bearing capacity.

industrial Production

The high cost of mold making and the adaptation of vacuum pressing techniques make this process ideal for small series. Larger series are possible with optimized tools and automated processes, but are associated with significantly higher costs. Metal molds designed for industrial use would increase efficiency and enable faster drying times. However, these molds are more expensive to produce and are a bigger investment, which is appropriate for a larger production.

Material and Manufacturing Features

The veneer's ability to bend into complex, three-dimensional shapes without breaking allows for innovative and sophisticated designs. The vacuum process demands uniform surfaces and avoids sharp edges, ensuring precision and quality in the finished product.

By combining thin but strong layers, the design achieves a lightweight yet stable structure. The curved forms also highlight the natural wood grain, enhancing its visual appeal.

Challenges in the Process

It was a challenge to ensure that the mold could withstand the high vacuum pressure. It was also tricky to handle the mold size efficiently with the limited machining capabilities of the workshop machines. During pressing, it was a challenging task to achieve consistent pressing results to produce four identical panels. When assembling, it was difficult to precisely bend the stainless steel profiles so that they were slightly tapered to hold the panels together and still remain detachable.

Does the Process dictate the Design Language?

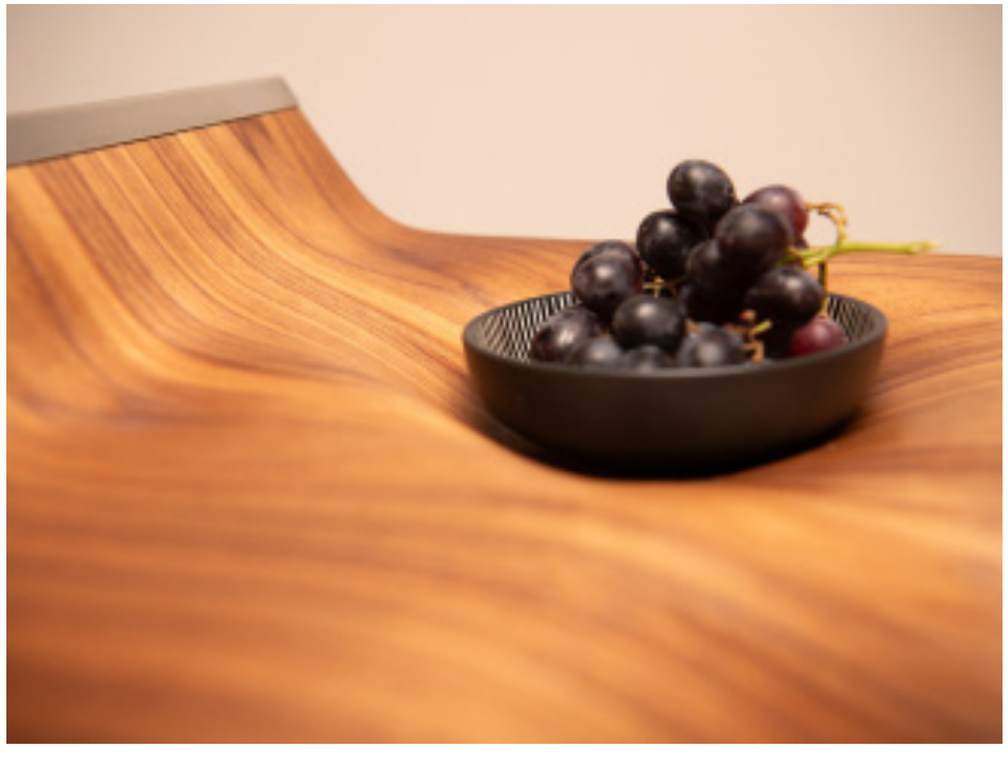
Yes, the vacuum forming process encourages an curved and minimalist design. Sharp edges and highly intricate branching structures are challenging to achieve due to material and process limitations.

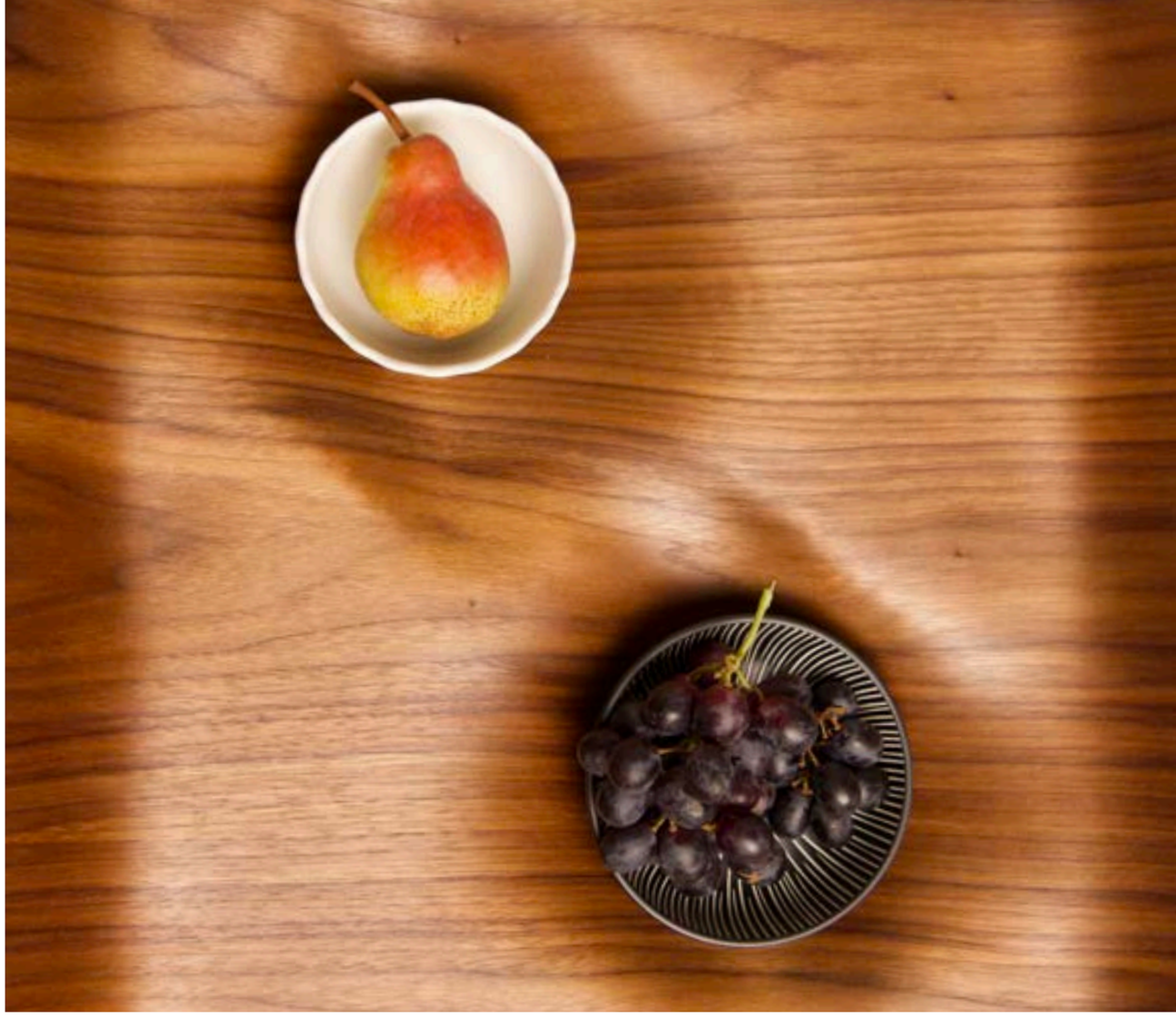
Key Insights

A four-layer pressing process ensures both stability and flexibility. Detachable yet stable joints can be produced, with continuous profiles improving stability. Plaster molds withstand vacuum pressure and can be used several times. Quick surface variations are easy to realize with plaster moulds. Another finding is that wood glue joins the layers together firmly enough so that no epoxy resin is required.

Areas for Improvement

The pressing mold can be set to the exact 45° angle required. With the workshop tools, it is possible to press veneer panels into the desired shape without leaving any residue. I had planned for a residue of 10 degrees, which later proved to be my undoing. More wood glue should also be applied during the next pressing so that the veneer panels are pressed evenly. I would also incorporate more surface variations to increase the tension and variety. It is also important to prepare the contour with adhesive tape before sawing so that the fibers are not damaged. It is then advisable to remove the tape promptly so that it does not leave any marks.





Objects placed on the table surface appear to visually merge with the indentations of the design. This creates a seamless interaction between the objects and the table's contours. The effect enhances the aesthetic harmony and uniqueness of the table's surface