# MATERIAL INSIGHTS:

Material insights

DANISH DESIGN CENTER
X DISTRIBUTED DESIGN PLATFORM

Distributed Design

Co-funded by the European Union

DDC

# MATERIAL INSIGHTS

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# FORE-WORD

## Imagine a world, where materials are valued, appreciated, and treated with the respect they deserve.

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( Introduction )

Materials shape our world, yet we often take them for granted and treat them as disposable conveniences. We believe that there is a great need to challenge and debunk myths and misconceptions about materials, rethink approaches, and make more responsible material choices—whether you are a designer, maker, or simply someone who interacts with materials every day. We tend to consume materials mindlessly, discard them carelessly, and replace them easily. Paradoxically, the problem is not that we are too materialistic—but that we are not materialistic enough. In fact, true materialism is about understanding, respecting, and engaging deeply with materials.

To change this, we need to rethink our approach. We must explore, experiment, and develop a greater empathy for the resources we have already extracted from the planet. While some materials may be better replaced in the future, the real challenge lies in learning to care for and extend the life of what already exists — whether natural or synthetic.

No material is perfect. Each has its strengths, limitations, and ideal applications. By starting to understand these nuances better, this can allow us to make more informed decisions, selecting the right materials for the right contexts and thinking about materials in a more holistic manner.

This resource encourages you to dive into eight different material categories discovering their pros, cons, potentials, relevant tools and procedures to get to know them and much more. Through unique insights and hands-on experiences and recommendations from dedicated designers and makers from the Distributed Design Platform community, the distinctive properties of the different material categories are highlighted, offering both practical knowledge, best advice and new perspectives. Whether you are looking to deepen your understanding or uncover new ways of thinking about materials, we hope this publication inspires a more thoughtful and appreciative approach to materials.

Enjoy the read.

Therese Balslev
DDC - Danish Design Center

Chapter 01

# CARD-BOARD

Photo credit · Cardboardlab

MATERIAL INSIGHTS · CARDBOARD

“Cardboard is not only versatile and inspiring but also an upcycling marvel – perfect for giving packaging material a second life and creating sustainable value in a creative way.”

Barbara Höller

# CONTRI-
# BUTORS

The main contributor of Chapter 1 · Cardboard is presented below.
The designer has provided us with knowledge, expertise, and perspectives concerning the material, allowing us to gain a unique insight into their work and personal relationship with the material category.

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( Barbara Höller ) ( Cardboardlab )

Barbara is the founder of Badala. With a deep passion for cardboard and extensive knowledge of its potential, she is dedicated to shaping the future by challenging our perceptions of this versatile material. She highlights its many uses and untapped opportunities, inspiring us to see beyond the ordinary. Committed to sustainability, Barbara strives to ensure that future generations understand the importance of protecting our resources.

Check Barbara out here → cardboardlab Badala

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# INTRO-
# DUCTION

( Introduction to the material category )

Each material category has a unique list of properties and their own way of being categorised and understood. We have asked the designer how they would categorise and explain the material category on an overall level.

The cardboard material category represents a lightweight, strong, and biodegradable material that is easily printable and customizable.

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( Categories of cardboard )

Corrugated Cardboard

Cardboard with a fluted or ridged layer between two or more flat liners, providing extra strength and durability. Ideal for shipping containers and larger products.

Solid Board

A dense and firm type of cardboard without corrugation. Often used as folding carton for food and cosmetics packaging, where factors such as stability and good print quality are important.

Specialty Cardboard

Made from coated or recycled materials, like PE-coated cardboard for moisture protection. Great for packaging that needs to withstand extended transport or humid conditions.

# PROS & CONS

Pros

Every material has its advantages, making it valuable for different applications.
Below is a breakdown of the key pros for the material category. Cardboard is:

A natural material

Tactile, tangible and easy to work with

Lightweight

Recyclable - up to seven times

A versatile material - easy to cut, fold, and glue, making it suitable for a wide range of uses; from primary to secondary packaging

Containing an unlimited use potential offering a high degree of creative freedom

Affordable and available

Resistant to wear

Safe to work with

Eco-friendly

Highly suitable for various printing methods, making it popular for branding and custom designs

Offering a variety of different densities and thicknesses, providing different levels of stability - particularly relevant for packaging needs

# PROS & CONS

Cons

At the same time, each material comes with challenges which should be considered. Below is a breakdown of the main cons for the material category. Cardboard...

Can quickly lose its strength and structure. This can make projects that require stability more difficult - especially limiting its use outdoors.

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Has a limited load-bearing capacity. Although cardboard is stable enough for many projects, it quickly reaches its limits with higher weight and pressure and can therefore break or become deformed with time.

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Requires careful handling - when cutting, folding, or gluing, caution is necessary as cardboard can easily bend or tear if not handled evenly or with too much pressure.

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# HUMAN RELATIONS

( Human relations to the material )

A material is more than just its physical properties; when engaged with by humans, it can evoke emotions, memories, and associations — an important dimension that fosters greater respect and empathy for the material. We asked the designer what emotions and associations the material evokes in her — whether through working with it or simply thinking about it.

## Associations

Nostalgia and childhood memories because cardboard can remind us of the simplicity and joy of childhood games where a lot could be created with few resources.

Connection and community since cardboard projects can encourage shared crafting and collaboration, making cardboard a medium that fosters a sense of togetherness.

## Emotions

Creativity and freedom. Cardboard gives the opportunity to create without limitations, unleashing human creativity.

Sustainability and responsibility. When working with a reusable material, it can give a sense of actively doing something good for the environment.

Satisfaction and joy. It can fill one with happiness to turn seemingly “worthless” materials into something new and useful.

# ROLE IN A CIRCULAR AGENDA

( The material's role in a circular agenda )

Each material has unique properties that determine its suitability for different contexts. Understanding these characteristics is crucial for applying materials effectively to support a circular agenda. Cardboard can contribute due to the following:

- → It is biodegradable and compostable when untreated
- → It supports reusable packaging systems in e-commerce and retail
- → It is a versatile, eco-friendly, and highly recyclable material, making it a good alternative to plastic and other non-biodegradable materials
- → The high recyclability contributes to efficient reuse in e.g. packaging solutions
- → It can be upcycled, allowing continuous repurposing and waste reduction
- → It is lightweight and cost-effective, supporting local production and simplifying logistics
- → It can enable sustainable product development through do it yourself projects and design objects, making eco-friendly design more accessible

# THIS MATERIAL IS AMAZING BECAUSE

"Imagine a material that offers endless possibilities for creativity while being eco-friendly, safe, and easily accessible – that's cardboard! Cardboard invites you to create something new without complicated tools or much effort. You can cut, fold, paint, and decorate it to make anything from toys and furniture to design objects. Cardboard is not only versatile and inspiring but also an upcycling marvel – perfect for giving packaging material a second life and creating sustainable value in a creative way."

Barbara Höller

# WE NEED TO RESPECT THIS MATERIAL BECAUSE

Cardboard is made from wood fibers, using valuable natural resources. It is essential to use these raw materials mindfully to minimize waste and protect the environment.

The material is ideal for upcycling as it is often used only once and then discarded. By treating it with respect, we can repurpose it multiple times, giving it new life and reducing waste production.

Compared to many other materials, cardboard is affordable and ecologically sound. When we use cardboard respectfully, we can create valuable products without burdening the planet.

Respecting materials like cardboard raises awareness of sustainability, especially for children and young people, who can learn to create something special from simple materials.

When we respect and reuse cardboard for various purposes, we support the circular agenda where products stay in use longer, reducing the demand for new raw materials.

# TOOLS

( Tools & procedures )

By highlighting a list of relevant tools as well as care and maintenance procedures that can be applied when working with the material, you gain an overview of how to start working with the material and how to take care of it - preferably on an ongoing basis - aiming to extend the lives of the products and materials.

Tools · Machines · Procedures

## ( Manual work with cardboard )

Cutter

Hot glue

Tape or wet adhesive tape

Bone folder or ruler

Utility knife

Die cut (useful for repeated designs)

## ( Non-manual processing techniques )

Laser cutter

# TOOLS



Care · Maintenance

Regular inspection · Check the cardboard regularly for cracks or damage to ensure it remains in good condition. In this way, one can act promptly and repair or replace parts if necessary.

Protection from moisture · Keep the cardboard in a dry place to protect it from moisture and dampness, as this can affect the stability and durability of the material.

Education and awareness · Share knowledge about the proper handling of cardboard and raise  awareness among others about the benefits of sustainable crafting and upcycling to promote a respectful approach to the material.

Make sure that the workspace you are operating in is clean and free of sharp objects that could damage the cardboard. An organized workspace helps maintain the integrity of the material.

Handle the cardboard carefully and gently. Avoid excessive pressure when cutting or folding to prevent bending or tearing.

Store leftover cardboard pieces neatly to prevent them from bending or crumpling. This helps  keep them in good condition for future projects.

Consider how to reuse/make good use of scraps. By using leftover pieces for smaller projects or details, one can contribute to reducing waste and ensure the cardboard continues to serve a purpose.

# CON-STRAINTS

( Creative constraints & attention points )

A creative constraint is any circumstance or condition that limits creative options in some way. Setting limitations is essential, as it can both foster greater creativity and encourage consideration of nature and the environment early in product development.

The designer has shared her suggestions for creative constraints that could be integrated into practice when working with this material category.

## Suggested constraints

Avoid using plastic in the designs with cardboard.

Taking a mono-material approach to enhance easy recycling - applying uniform materials whenever possible to simplify the recycling process.

Using the maximum of cardboard - All cardboard (pieces) should be fully utilized and creatively encouraged to repurpose any leftover materials in new projects.

Producing as locally as possible. Aiming for short transport distances to reduce $CO_2$-emissions.

Aiming for zero waste from leftovers - explore how production waste can be minimized or repurposed for new products as much as possible.

# CON-
# STRAINTS

To work sustainably and responsibly with the material,
it is essential to consider key attention points in its use.

Attention points

Use well-preserved cardboard from recycled paper. If acquiring new cardboard, choose recycled quality. Remember to consider and investigate the source of the wood to ensure responsible production.

Design projects to minimize waste by utilizing leftover pieces for smaller components or creative purposes, working with a zero-waste approach.

Avoid using harmful additives and instead aim for eco-friendly adhesives, paints, and coatings that maintain the recyclability of cardboard. Avoid therefore plastics, laminations, or additives that are hindering the recycling of the cardboard.

Focus on designs that encourage users to reuse or redesign cardboard after its original use, sharing knowledge on its versatile applications. In this way, reusability and upcycling can be promoted.

Collaborate with local suppliers to reduce transport emissions and support the local economy as a way of supporting more sustainable supply chains.

Share knowledge about the environmental benefits of cardboard and guide others toward sustainable practices, aiming to foster increased environmental awareness and responsible use of the material.

# ADVICE

Discover expert advice from designers on working with each material — whether you are looking to deepen your understanding or start prototyping.

## The makers' best advice

Start with simple projects

Talk to people with experience in working with cardboard

Use existing resources and platforms to learn about cardboard

## Start getting to know the material

Start experimenting with cardboard by bending, folding, layering, and cutting to understand its strength and flexibility

Perform a water and durability test where you observe how cardboard reacts to moisture, pressure, and repeated use

Some suggestions for simple projects to start with could be simple boxes to explore cardboard's load-bearing potential or to make a small stool, laptop stand, or phone holder to test structural properties

## When prototyping with the material, think about the following

Plan efficiently to minimize waste by carefully plan cuts and dimensions to use the material as efficiently as possible, which reduces waste. Measuring and drawing outlines before cutting can help avoid unnecessary scraps.

Start small when it comes to prototypes related to more complex projects. Start with smaller sections or scaled-down models to test ideas without using too much material. In this way, you can refine the design before moving to a full-scale version.

Use scrap pieces for testing in case there are leftovers. Use these for testing cuts, folds, and glue application rather than using fresh material each time.

Pay attention to fold directions and grain. Since cardboard has a natural grain direction, this affects its flexibility and strength. Understanding the grain helps in planning folds and ensuring structural integrity.

When it comes to structures that require durability, layering cardboard can add strength without needing additional materials.

Recommendation 01

# CARDBOARDLAB

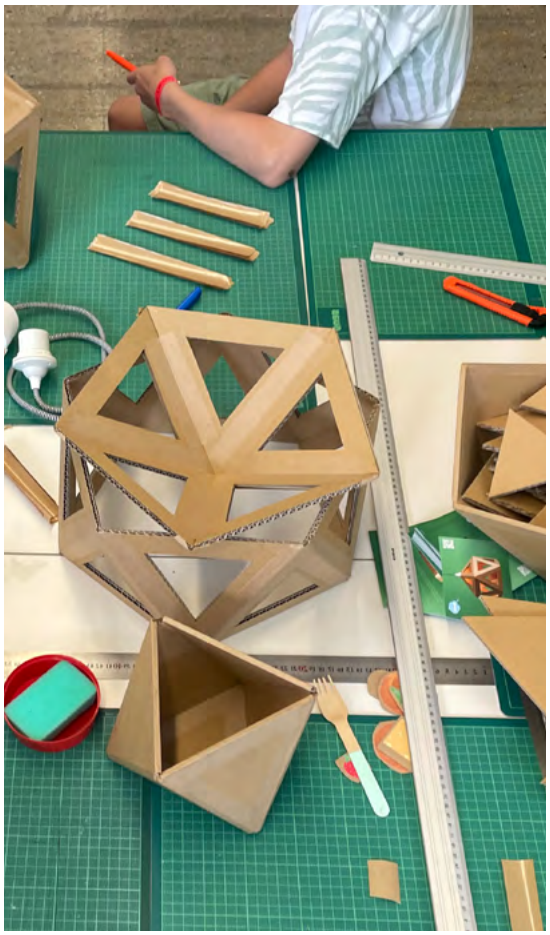
An example from the project initiative, Cardboardlab, is the DIY cardboard lamp. This lamp combines functionality and design. It is made exclusively from recycled cardboard found in paper recycling bins, showcasing the versatility and stability of cardboard – all without plastic or additional materials. It is easy to design and build, making it ideal for DIY beginners as well as craft enthusiasts.

With precise cutting and folding techniques, the cardboard can be transformed into a stable structure that is both light-transmitting and decorative. The lamp combines minimalist design with sustainability, serving as an example of how cardboard can inspire creative and eco-friendly solutions.

Learn more →

cardboardlab

Badala



Chapter 02

# CERAMICS & CLAY

Photo credit · Pjorkkala

MATERIAL INSIGHTS · CERAMICS

“This is a regenerative material which can be collected in nature, used as many times as possible, and when fired - can be preserved forever (until broken).”

Pia Groleger

# CONTRI-BUTORS

Each of the contributors of Chapter 2 · Ceramics and clay are presented below. The designers have provided us with their knowledge, expertise and perspectives concerning the material and given us a unique insight in their experience and personal approaches to the material.

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( Irena Übler ) ( PRIMA MATTERS )

Irena Übler is a product and furniture designer based in Porto, Portugal.
Irena creates unique design solution for products, raising awareness of sustainable materials and exploring urban territories and creative culture with design.

Check Irena out here → Web @prima_matters

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( Karim Asry ) ( JetClay )

Karim Asry is the creative director at Espacio Open in Bilbao, Spain. He represents the project, JetClay, which is an open source platform that explores the world of 3D printing and ceramics, relating the digital and the analog, tradition and technology, makers and ceramists.

Check it out here → Web @jet_clay

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( Pia Groleger ) ( Pjorkkala )

Pjorkkala, founded in 2021 by Žan Girandon, Pia Groleger, and Luka Pleskovič, brings expertise in industrial, interior and product design. The collective explores ceramics through sustainability and experimentation. By blending modern technology with traditional knowledge, Pjorkkala pushes design boundaries while considering its societal and environmental impact. In this chapter, we benefit from Pia's insights and her experiences as a co-founder of Pjorkkala.

Check them out here → Web @pjorkkala

# INTRO-
# DUCTION

( Introduction to the material category )

Each material category has a unique list of properties and their own way of being categorised and understood. We have asked the designers how they would categorise and explain the material category on an overall level.

Ceramics, made primarily from natural clay, has been used for thousands of years due to their durability, heat resistance, and unique aesthetics. Formed by shaping and firing at high temperatures, they retain structural integrity for centuries. Their suitability depends on the application—whether for functional, artistic, or industrial uses.

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( Categories of ceramics )

1. High temperature clay · Stoneware
Fired at higher temperatures, stoneware is dense, durable, and resistant to chipping and cracking. It is commonly used for dinnerware and cookware.

2. Low temperature clay · Earthenware
A type of ceramic that is fired at lower temperatures, making it more porous and less durable. Often used for decorative items and pottery.

3. High temperature clay · Porcelain
A high-fired ceramic known for its strength, translucency, and aesthetic appeal. Often used for fine china and high-quality decorative items.

4. Low temperature clay · Terracotta
A type of earthenware made from red clay, often used for pottery, tiles, and sculptures. It is porous and usually left unglazed.

5. Refractory Ceramics
Designed to withstand high temperatures, these ceramics are used in applications such as kiln linings and furnace components.

Overall, understanding these sub-categories of ceramics helps highlight their diverse applications and qualities, making them a fascinating material in both artistic and practical contexts.

Different colour options for clay:
1. Red
2. White
and by adding minerals and pigments the color can be changed.

Types of clay in its raw format:
1. Clay in bricks
2. Clay in powder

# PROS & CONS

Pros

Every material has its advantages, making it valuable for different applications.
Below is a breakdown of the key pros for the material category.

| |
|---|
| Natural material |
| Long livability and high durability - can last for generations |
| Local sourcing is often available |
| Reusable (if not fired) |
| Can be used for food |
| Can hold water |
| Clay mixed with organic material can filter water after it has been fired |
| Has a natural beauty and texture - the unique textures and finishes of ceramics enhance the visual appeal, offering a tactile quality that is satisfying to work with |
| Ceramics are chemically stable and generally non-reactive, making them ideal for use in environments that may involve exposure to chemicals |
| Resistant to wear |
| Can be collected in nature |
| High heat resistance and can withstand high temperatures |
| Offers great artistic freedom with versatile applications, from functional items to intricate sculptures |
| Can be glazed or left unglazed, allowing for a variety of finishes as well as aesthetic and artistic expressions |
| The material holds cultural and artistic value, deeply rooted in history and craftsmanship, which helps connect artists to traditional methods and cultural practices |
| Possible to recycle after firing, but challenging—only a small percentage is typically reused in the industry. Fired ceramics do not absorb water, making reintegration into new clay difficult, thus smart design is key to leveraging their properties effectively |

# PROS & CONS

Cons

At the same time, each material comes with challenges which should be considered. Below is a breakdown of the main cons for the material category.

Has to be glazed in order to be able to hold water

Can be unpredictable

Ceramics tend to be brittle and are therefore prone to cracking or breaking under impact, which can be frustrating when handling or transporting pieces

The process of shaping, drying, and firing ceramics can be time-consuming, which requires patience and careful planning

The production of ceramics is energy-intensive as the firing process requires significant energy, raising concerns about environmental impact

Limited reworkability · Once ceramics are fired, they cannot be reshaped or repaired easily, which can be a drawback in certain projects

For recycled ceramics · If one wishes to reuse residues of ceramics that has already been fired, it is necessary to grind it into a fine powder, which requires proper machines/equipment

For recycled ceramics · The higher percentage of recycled components in the composition of ceramic clay the more complicated is it to work with it and get good results. It is difficult to make thin walls and high objects. The drying process is more tricky than if you work with 100% pure clay

# HUMAN RELATIONS

( Human relations to the material )

A material is more than just its physical properties; when engaged with by humans, it can evoke emotions, memories, and associations—an important dimension that fosters greater respect and empathy for the material. We asked the designers what emotions and associations the material evokes in them—whether through working with it or simply thinking about it.

## Associations

It is possible to turn the material from trash to treasure (based on recycled ceramics)

The material can make you feel connected with nature

Nostalgia · Working with clay often evokes memories of childhood art projects and hands-on creativity

Community · Ceramics often fosters connections among artists, encouraging collaboration and shared learning

## Emotions

Satisfaction · The process of molding and shaping brings a deep sense of accomplishment and connection to the material

The material provides us with a deep feeling of happiness

The material allows for playfulness

Can be a struggle to work with - frustations is part of working with clay and ceramics

Calmness · The tactile nature of ceramics can be meditative, promoting a sense of focus and tranquility.

# ROLE IN A CIRCULAR AGENDA

( The material's role in a circular agenda )

Each material has unique properties that determine its suitability for different contexts. Understanding these characteristics is crucial for applying materials effectively to support a circular agenda. Ceramics and clay can contribute due to the following:

- → Promoting longevity - the durability of ceramics encourages the creation of long-lasting products that reduce the need for frequent replacements. Ceramics are a long-lasting material - especially when it is being treated right and carefully.
- → Utilising natural materials - sourcing clay and glazes from local, sustainable sources can help minimize environmental impact.
- → Recyclability - broken ceramics can often be ground down and repurposed, contributing to circulating resources.
- → Clay can be a great alternative to some less sustainable materials. For example, one can use a ceramic cup instead of a plastic one.
- → Repairability and long lifespans can help reduce waste.
- → Potential for downcycling into aggregates for construction materials.
- → Encouraging long-term use and repair over disposability is essential for sustainability.

# THIS MATERIAL IS AMAZING BECAUSE

"Think about the uniqueness that new material compositions with this material can provide us with..."

Irena Übler · PRIMA MATTERS

"Clay is a regenerative material which can be collected in nature, used as many times as possible - and when fired - can be preserved forever (until broken)."

Pia Groleger · Pjorkkala

"When focusing on Ceramic 3D printing, this is a revolutionary material process that bridges ancient craftsmanship with cutting-edge technology, transforming clay—a medium with thousands of years of history—into intricate, customizable designs that were once impossible to create. It combines the tactile beauty of traditional ceramics with the precision and versatility of digital fabrication, offering endless possibilities for art, architecture, and functional design."

Karim Asry · JetClay

# WE NEED TO RESPECT THIS MATERIAL BECAUSE

"Clay is a natural material and should be treated with respect and care."

Pia Groleger · Pjorkkala

"Respecting ceramics as a resource is essential because they embody centuries of craftsmanship and cultural heritage, hold significant artistic value, and encourage more sustainable practices through thoughtful sourcing and usage."

Karim Asry · JetClay

"By recycling clay, we honor its timeless, sustainable nature, proving that even broken pieces can be reborn as new material, applied in design or art, creating a new object and giving a second function - and this can even lead to innovation."

Irena Übler · PRIMA MATTERS

# TOOLS

( Tools & procedures )

By highlighting a list of relevant tools as well as care and maintenance procedures that can be applied when working with the material, you gain an overview of how to start working with the material and how to take care of it - preferably on an ongoing basis - aiming to extend the lives of the products and materials.

Tools · Machines · Procedures

## ( Manual clay forming techniques )

Hand tools: Clay knives, wire cutters, rolling pins, ribs, wooden modeling tools

Molds: Plaster or bisque molds for slip casting or press molding

Pottery wheel: To throw symmetrical forms e.g. bowls, cups, and other functional items

Slab roller: For creating flat sheets of clay (e.g. for tiles or larger construction pieces)

Extruder: To produce consistent and uniform shapes like coils, tubes, or intricate patterns which is ideal for larger projects

## ( Non-manual clay forming techniques )

Ceramic specific 3D Printer where clay-based filaments are applied. This method can assist producing intricate ceramic designs, allowing for precise control over form and detail

## ( Firing )

Kiln (ceramic oven) - used to fire the pieces - first on lower temperature, then on a higher temperature depending on what material is used. Firing ceramics is helping achieve the durability and strength the material provides

Various types of kilns exist - e.g. electric, gas and wood-fired upon which the outcome also is depending

# TOOLS

## Care · Maintenance

Handle ceramics gently and with care. It is a fragile material, so make an effort not to let it fall. Remind yourself of this when handling or being around it

Regular cleaning · Use gentle cleaning methods to maintain the finish and integrity of the pieces, especially for glazed surfaces. Use mild soap and warm water when cleaning

Avoid abrasive cleaners · Scrubbing pads or harsh chemicals can damage glazes and finishes

Repair ceramics with food-safe glue · The Japanese Kintsugi technique can be applied here

Avoid sudden temperature changes · It prevents cracking by not exposing ceramics to extreme temperature changes (e.g., moving from freezer to oven)

Check for microwave and dishwasher safety as not all ceramics are safe for these appliances, especially those with metallic or delicate glazes

PROJECT INSIGHT

### Attention point when working with recycled clay/ceramics

"I focus on developing ceramic recipes by experimenting with various waste components derived from ceramics. This includes finely grinding broken or discarded ceramic pieces into a thin powder, which acts as a key ingredient in new material compositions. The primary challenge lies in maximising the quantity of recycled ceramic content while ensuring that the resulting material retains the desired properties - such as strength, durability, and aesthetic appeal. This experimental process requires meticulous testing and iteration as the inclusion of high quantities of recycled ceramics can sometimes affect the material's performance. Factors such as particle size and adapting firing temperatures to find a good balance is not easy and takes quite some time. My goal is to create a final good material composition and final results. Documenting precisely all information in the process is very important but also quite a creative limitation."

Irena Übler, PRIMA MATTERS

# CON-STRAINTS

( Creative constraints & attention points )

A creative constraint is any circumstance or condition that limits creative options in some way. Setting limitations is essential, as it can both foster greater creativity and encourage consideration of nature and the environment early in product development.

The designers have shared their suggestions for creative constraints that could be integrated into practice when working with this material category.

## Suggested constraints

Only source locally - to minimise transport and to support local artisans

No Waste Production - aim to minimize waste e.g. by reusing clay scraps and create designs that maximize material efficiency

Avoid creating designs that need glazing so that firing twice can be avoided and energy can be saved

Work with - and embrace - different aesthetics. Meaning you can work on allowing “flaws” and deviations in the designs

When 3D-printing the material, a natural limitation occurs due to the softness of the material. Therefore, one needs to work on how to stabilise the design

# CON-
# STRAINTS

To work sustainably and responsibly with the material, it is essential to consider key attention points in its use.

**Attention points**

Think twice before firing the objects. When feeling unsure about the design/creation, avoid firing

Reflect upon whether glazing really is needed

Ensure that what is being fired also will have a long life

Focus on longevity · Prioritizing long-term use, repair, and maintenance as this is more sustainable than relying solely on recycling

Source responsibly · Look for local suppliers that prioritise sustainable practices in their material sourcing

Specialised recycling is required and recycling options are limitd for ceramics. Recycling ceramics often needs industrial facilities, which are not widely accessible. Also, most waste sorting systems do not accept ceramics, leading to disposal in general waste

Make sure to minimize waste. Implement practices to reuse clay scraps and optimise material usage throughout the production process

Downcycling predominance · Ceramics are typically repurposed as fillers for construction rather than recycled into new ceramic products

Filter your waste water to avoid destroying the water pipes and lose material - the clay sediment in the waste water can be reused

# ADVICE

Discover expert advice from designers on working with each material
— whether you are looking to deepen your understanding or start prototyping.

## The makers' best advice

Test various techniques - you never know which one will suit you the best

Test as much as possible and be patient. Ceramic processes are slow and cannot be rushed. Remember that you need a lot of patience, nothing will turn out as wished in the beginning

Connect with local studios - reach out to local pottery studios or community centers for workshops and resources to get started

## Start getting to know the material

You could start using clay by creating a small and simple bowl or mug.
This is a good way to practice basic shaping and glazing techniques

Another easy technique to get started is “PINCHING” :

1. Knead the clay thoroughly and soften it in your hands, rolling it into a ball
2. Make a hole in the ball by pushing your thumb into the middle of the clay ball, keeping 2-3 fingers on the outside of the ball
3. Pinch further to make the walls evenly thin
4. Smooth the clay with a bit of water on your fingers

## When prototyping with the material, think about the following

Quite a lot of practice is needed to understand the way of shaping clay manually. Ask at ceramic studios if they have leftover clay that they will not use, so while practising, you actually reuse

Avoid firing a piece if you are not 100% convinced that it is a good one. Because once fired, the recycling process is much more complicated or even impossible if you do not have the proper equipment

Do not glaze your prototype if you can find a way to avoid it

Make sure you understand the appropriate firing temperature for the specific type of clay being used

Design for strength · Creating designs that account for the inherent brittleness of ceramics to avoid breakage

Moisture levels · Ensure the right moisture content in the clay to prevent cracking during drying

Recommendation 01

# PRIMA MATTERS

In 2022 Irena Übler started the material research and project development of PRIMA MATTERS - Rethinking sustainable materials with a research focus on local residues of cork, ceramic, paper and plastic within the framework of the application for the European Capital of Culture Aveiro 2027.

Therefore, Irena tested various types of ceramic residues, ranging from unfired clay to fired ceramics with and without glazing. These materials were sourced from construction sites, industrial byproducts, discarded pieces from ceramic ateliers and universities as well as household ceramic waste. Through this research, she explored the potential of repurposing these materials, assessing their properties and suitability for sustainable design applications. PRIMA investigates the materials and waste generated during ceramic production, their reuse, and the transformation into the materialisation of recycled ceramic clays. During the last two years, around 150 different ceramic compositions have been tested where slip-casting moulds are used for the material samples generated. In this way, Irena can guarantee that all the pieces are more or less the same size (despite having different shrinkage depending on the material composition). Moreover Irena collaborates with local ceramic artists to try out clay recipes on traditional tecniques like the pottery wheel or manual forming.

Learn more →

Web | Ceramics · PRIMA | @prima_matters

Recommendation 02

# KADUJA BY PJORKKALA

Kaduja is a product designed for dough rising, baking, and storage, with the aim of rekindling the tradition of homemade bread production. By focusing on the pervasive issue of bread waste, which accounts for 44 pct. of Europe's food waste, Kaduja addresses this concern strategically. It offers a sustainable approach to reducing food wastage, emphasizing responsible consumption while preserving culinary heritage. Kaduja consists of two 3D-printed ceramic vessels that provide an ideal experience during all three stages of bread making, making the process easy even for inexperienced bakers. For dough rising, the vessel that acts as the lid is used in combination with a cotton kitchen cloth. While the dough rises, the second vessel, which serves as the base, is preheated in the oven.

When the dough is ready, it is transferred to the preheated base and covered with the lid filled with water. The use of water during baking results in a loaf that is crunchy on the outside yet soft on the inside. After baking, the bread can be stored in the vessels. Due to the 3D clay printing technology, a bread baked in Kaduja bears a distinctive pattern, created by the layering process inherent to this technology. Since bread making requires breathable materials, natural clay was chosen. The process avoids glazing, allowing the clay's natural ability to regulate moisture to enhance the baking experience. Additionally, the technology encourages small-batch production, creating just the right amount of pieces needed at a given time, and thereby discourages mass production.

Learn more →

Kaduja | Web | @pjorkkala

Photo credit · Pjorkkala

Recommendation 03

# YETDUST BY JETCLAY

JetClay is an open source Platform that explores the world of 3D printing and ceramics, relating the digital and the analog, tradition and technology, makers and ceramists. They develop their own tools to make unique pieces of ceramics at the crossroads among industrial design, architecture, interior design and sculpture.

Geological formations—arches, cliffs, and stone runs—are shaped over time by nature, becoming symbols of a cultural identity. The project, YetDust, explores the reverse process: from culture to nature. Using clay from Monegros' soil, JetClay digitally transforms the clay through 3D printing and turn it into cultural artifacts. These artifacts will be shaped not by full-body scans but by capturing the emotions and gestures of festival participants, merging human presence with the landscape. Once printed, the pieces will return to the soil they came from. Exposed to the elements, they will erode, dissolve, and eventually return to dust—completing the cycle of transformation, where everything becomes, yet everything is dust.

Learn more →

Web | @jet_clay

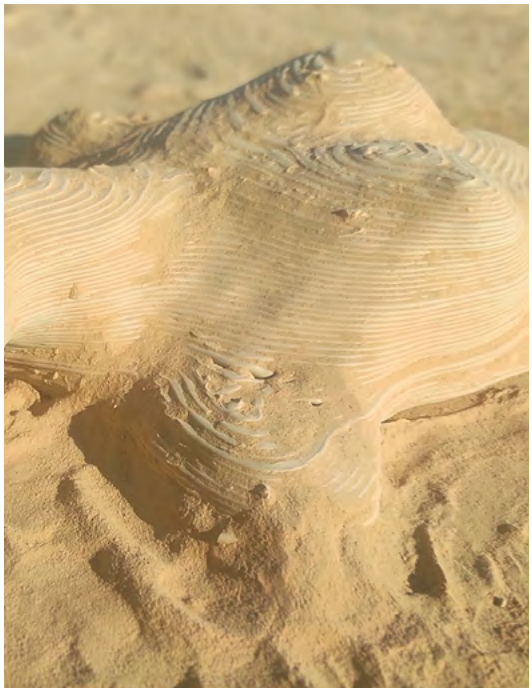

Photo credit : JetClay

Chapter 03

# ELEC-TRONICS

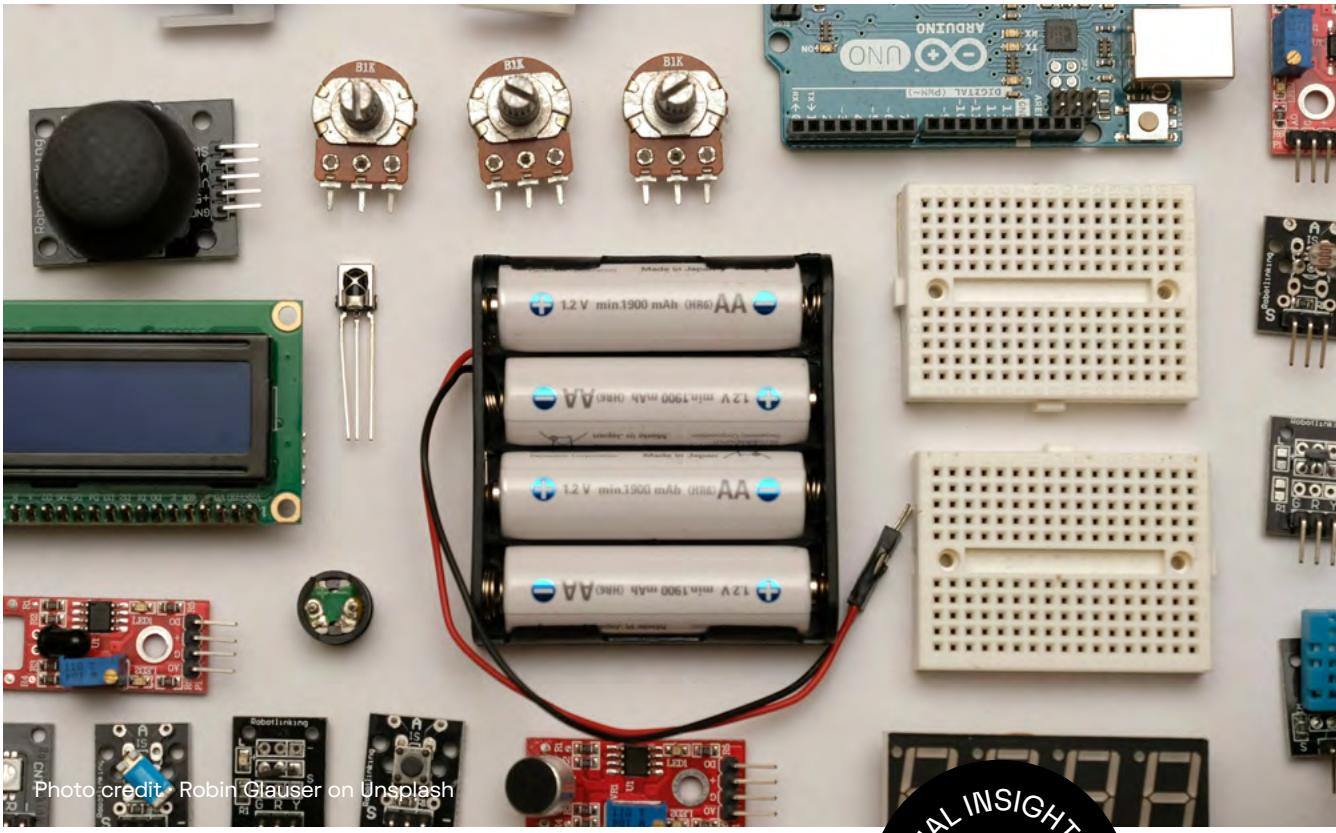


Photo credit - Robin Glauser on Unsplash

MATERIAL INSIGHTS · ELECTRONICS

"I think we need to make this material more desirable and think of how projects concering electronics can make it into fields other than high-tech electronics."

Gautier Lemesle

# CONTRI-
# BUTORS

The main contributor of Chapter 3 · Electronics is presented below.
The designer has provided us with knowledge, expertise and perspectives concerning the material and allowed us to gain a unique insight in their work and personal relation to the material category.

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( Gautier Lemesle ) ( Break Fast But Repaired )

Gautier is a Paris-based designer working with upcycling electronics primarily focusing on how to imagine desirable alternatives for our small kitchen appliances.

Check Gautier out here → @galem_fr

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# INTRO-DUCTION

( Introduction to the material category )

Each material category has a unique list of properties and their own way of being categorised and understood. We have asked the designers how they would categorise and explain the material category on an overall level.

Electronics is the material category that combines metals, plastics, and complex components to serve functions related to e.g. communication, energy, and data. The material category has a high material complexity and also includes rare and valuable metals.

---

( Understanding electronics )

When talking about electronics, one can think of this material category as consisting of the three following sub-groups:

· Electronic boards

Main materials used for basic surfaces are copper, resin and glass fabric

· Electronic components

The electronic components are made of copper, plastics, silicone and rare metals (e.g. neodymium, promethium, cobalt samarium, gadolinium etc.)

· Electronic components added

Resistors, capacitors, inductors, transformers, potentiometers, diodes etc.

# PROS & CONS

## Pros

Every material has its advantages, making it valuable for different applications.
Below is a breakdown of the key pros for the material category.

Electronics hold special properties like being:
— Magnetic
— Chemical stability
— Piezoelectric (i.e. the ability to generate electric charge when mechanical stress is applied)
— Luminescent (i.e. light emitted that is not caused by heat)

---

Availability aspects - useful parts and components can be found in large quantities in unused appliances in landfills or domestic environments - e.g. old smartphones, household appliances no longer in use but not yet recycled and more

---

Increasingly crucial to the operation of our frequently used appliances

---

## Cons

At the same time, each material comes with challenges which should be considered.
Below is a breakdown of the main cons for the material category.

It can be difficult to separate electronics when wanting to recover the original materials (but possible)

---

Very precise and cutting-edge techniques are needed to manufacture electronics

---

It is a toxic material - especially the resin parts when heated and inhaled.

---

Electronics have a particular aesthetic, which is often associated with technology.
This is difficult to challenge when wanting to take it into another field - e.g. craftsmanship

---

Some components (such as capacitors) can retain a residual electrical charge - even when unplugged. So you need to learn how to drain off this residual electricity.

---

# HUMAN RELATIONS

( Human relations to the material )

A material is more than just its physical properties; when engaged with by humans, it can evoke emotions, memories, and associations — an important dimension that fosters greater respect and empathy for the material. We asked the designers what emotions and associations the material evokes in them—whether through working with it or simply thinking about it.

Emotions

Empathy · As I look at these circuits, these assemblies, wondering whether it is an automatic arrangement defined by a computer program or a person who has chosen this arrangement

A feeling of discovery, like a little scientist when exploring the complexity

Empowerment

# ROLE IN A CIRCULAR AGENDA

( The material's role in a circular agenda )

Each material has unique properties that determines its suitability for different contexts. Understanding these characteristics is crucial for applying materials effectively to support a circular agenda. Electronics can contribute due to the following:

- → It could take up more space as soon as we seek to create products that are magnetic, luminescent or break with traditional aesthetics
- → We can explore further and broaden the horizons of how eletronics are being used and the application contexts
- → We need to be willing to break with aesthetic values and perceptions to a greater degree than we currently are, in order to take advantage of the material category
- → There is a great potential for component reuse and material recovery (e.g. metals)
- → The product life could be extended through repair and modular design approaches
- → E-waste could be reduced through improved recycling technologies and collection systems

## THIS MATERIAL IS AMAZING BECAUSE

"Electronic materials are ubiquitous and necessary to power our everyday devices like smartphones, computers and household appliances etc.
And against all expectations, this material is the exception in the recycling circuit. Whilst low-cost mining operations continue around the world - without paying the necessary attention to design and recycling - this material is already present in obsolete appliances in Europe.
Behind its aesthetic lack of charm, electronic materials imply multiple major contemporary issues that need to be collectively thought through in order to protect ourselves if we wish to live in a truly desirable and technically sustainable society."

Gautier Lemesle

## WE NEED TO RESPECT THIS MATERIAL BECAUSE

"This material must be respected and treated with the utmost care, seeing through the arduous extraction carried out under harsh conditions, as well as the precision and ingenuity with which it has been shaped so that its functioning emerges."

Gautier Lemesle

# TOOLS

( Tools & procedures )

By highlighting a list of relevant tools as well as care and maintenance procedures that can be applied when working with the material, you gain an overview of how to start working with the material and how to take care of it - preferably on an ongoing basis - aiming to extend the lives of the products and materials.

Tools · Machines · Procedures

## ( Manual handheld tools )

- Silicone mold (possible with tin)
- Wire strippers
- Screwdrivers and precision set
- Tweezers
- Pliers (needle-nose and cutting)
- Soldering iron and solder wire
- Desoldering pump/wick
- Breadboard and jumper wires (good for prototyping without soldering)

## ( Machines )

- CNC
- Scroll saw
- Oven with filter

# TOOLS



Care · Maintenance

| |
|---|
| Keep away from moisture |
| Dust regularly |
| Beware of shocks |
| Use microfiber cloths to wipe screen and casings without scratching them |
| Provide proper ventilation - keep electronics in well-ventilated areas to avoid overheating |
| Avoid direct sunlight and heat sources – exposure to this can degrade components and batteries |
| Store electronics in dry, dust-free spaces – this protects electronics when not in use |

# CON-STRAINTS

( Creative constraints & attention points )

A creative constraint is any circumstance or condition that limits creative options in some way. Setting limitations is essential, as it can both foster greater creativity and encourage consideration of nature and the environment early in product development.

The designer has shared his suggestions for creative constraints that could be integrated into practice when working with this material category.

## Suggested constraints

- Only use salvaged or second-hand parts. Avoid buying new components; work with what you can find
- Limit the number of components to the greatest extend possible
- Prioritize modularity – ensure everything can be taken apart and repurposed again
- Use low-power or renewable energy
- Self-sustaining systems – try to design electronics that power themselves or minimize energy use
- Natural dimensional constraints when working with reusing and repurposing household appliances
- Make sure everything is disassemblable – everything should be easy to take apart and fix in the future

# CON-
# STRAINTS

To work sustainably and responsibly with the material, it is essential to consider key attention points in its use.

Attention points

| |
|---|
| Pay attention to the toxicity of the materials for close-to-home use (cutlery, plates, dishes) |
| Always disconnect power sources before working on a device to avoid electric shock |
| Ensure proper insulation and wiring |
| Ensure correct orientation of batteries, capacitors, and diodes to avoid damage |
| Use components rated for the correct voltage and current to prevent overheating or failure |
| Ensure proper cooling for power-intensive components |
| Recycle electronic waste properly instead of discarding it |
| Modular design – design electronics in a way that makes future repairs or upgrades easy |

# ADVICE

Discover expert advice from designers on working with each material
— whether you are looking to deepen your understanding or start prototyping.

## The makers' best advice

We need to be in dialogue with existing recycling circuits to improve the following:
- Reduce the amount of unused appliances still in the home (particularly smartphones and household appliances)
- Diversify the players seeking to reuse this material
- Share a culture of discovery, making and repairing

We need to think about how to make this material more desirable and work on projects that can be taken into fields other than the high-tech electronic field

## Start getting to know the material

A simple way to get to know about basic circuit wiring, using resistors, and understanding polarity is to make an LED blinker. Here you connect a battery, resistor, and LED in a series to make it light up

## When prototyping with the material, think about the following

If heat separation operations are involved, a mask, goggles and a filter hood are required

Check whether the material is connected to the power supply and make sure to disconnect it

Remember to allow to dry, then reconnect power to avoid short-circuiting

Test before final assembly – use a breadboard or temporary setup before soldering components permanently

Recommendation 01

# BREAK FAST BUT REPAIRED

Reinventing Small Household Appliances with Circular Economy

Small household appliances like toasters and coffee makers are often treated as disposable, but a new approach developed by the designer, Gautier Lemesle, is proving they can have a second life. Through circular design, discarded appliances are dismantled, with functional components carefully identified and repurposed. Their original plastic or steel casings are replaced with custom 3D-printed ceramic shells made from high-quality, sometimes recycled materials, enhancing both durability and aesthetics. Even power cables are reworked with wool braids, adding an unexpected touch of craftsmanship.

Lemesle's approach was showcased at Vienna Design Week 2024 in the "Break Fast But Repaired" workshop, where visitors explored how everyday appliances can be transformed into luxury objects through repair and reinvention. By integrating artisanal techniques and innovative materials, the project demonstrates how circular design can reduce waste while fostering a deeper connection between users and their devices.

More than just a repair initiative, this project challenges conventional consumption habits, proving that sustainability and high-end design can go hand in hand. It invites us to rethink our relationship with household objects—not as disposable conveniences but as valuable, long-lasting items that can evolve with time.

Learn more →

@galem_fr

Chapter 04

# METAL & ALLOYS

Photo credit - Annie Spratt on Unsplash

MATERIAL INSIGHTS · METALS

"Metal has been a cornerstone of human progress, shaping both our past and modern society. Without it, we would never have moved beyond the Stone Age, and many of our most significant innovations — such as computers — would not have been possible".

Tatjana Aranka

# CONTRI-BUTORS

The main contributor of Chapter 4 · Metal & alloys is presented below.
The designer has provided us with knowledge, expertise and perspectives concerning the material and allowed us to gain a unique insight in their work and personal relation to the material category.

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( Tatjana Aranka Schinko ) ( University of Arts Linz )

Tatjana Schinko is an Austrian artist and educator focused on community engagement and creative interventions in public spaces. She co-founded “Experimental Utopia,” led welding workshops for all kind of people - especially for women and girls - and contributed to theater set design. Her work spans empowerment, participatory art, maker culture, and urban creativity.

Check her out here → Web

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# INTRO-DUCTION

( Introduction to the material category )

Each material category has a unique list of properties and their own way of being categorised and understood. We have asked the designers how they would categorise and explain the material category on an overall level.

Metal and alloys are known for being a material category that is durable, strong, and conductive. It is also able to withstand heat and environmental stress which is part of what makes this material category unique.

---

( Categories of metals )

The metal material is divided into the following 2 categories:

1. Ferrous metals
2. Non-ferrous metals

The ferrous metals (1.) include steels (e.g.: unalloyed structural steel, tool steel, tempering steel) and the iron cast materials e.g.:

— Cast iron
— Malleable cast iron
— Cast steel

The non-ferrous metals (2.) are in turn divided into heavy metals e.g.:

— Copper
— Zinc
— Lead
— Chromium
— Nickel

— And light metals like aluminum, magnesium, titanium etc.

# PROS & CONS

Pros

Every material has its advantages, making it valuable for different applications.
Below is a breakdown of the key pros for the material category.

Robust, durable and versatile material with high strength. Can be used for contexts requiring high durability demands like furniture, machines, bridges, vehicles, and even houses

Recycling metal is possible and the infrastructure for this already exists in many cities

Steel: is inexpensive and easy to get hold of and work with

Diverse material properties and areas of application. Many different types and sorts of metals exist which have a wide range of properties, which in turn can be combined to form many alloys (mixtures of materials)

Interesting and useful properties of the material like electrical, thermal conductivity and formability in different forms

BONUS INSIGHT

The specific properties of the different metals can be used in many different areas of application.
For example, copper has very good electrical conductivity and is therefore used in cables. Light metals are, as the name suggests, very light and are therefore used a lot in vehicle construction.
But even the different components of a vehicle or machine are made of different metals in order to perfect the function of the components.

# PROS & CONS

Cons

At the same time, each material comes with challenges which should be considered. Below is a breakdown of the main cons for the material category.

| |
|---|
| Steel is susceptible to rust, requiring protective storage (e.g. oiling) |
| When processing, it generates dust, toxic fumes, and is dirty, making home processing difficult |
| Transport of items can be an issue due to the weight of the material |
| Involves risks such as high heat, sharp edges, rotating machines, electricity, and heavy parts (NB depends on the processing method) |
| Stable connections often necessitate welding rather than simpler methods like screwing or gluing |
| Time-consuming pre- and post-processing steps (as the corrosion and/or protective layers have to be removed before processing). This includes sanding, degreasing, and removing dust. At the end of processing, sanding again and sealing the surface with oil or varnish is usually necessary |
| Working with the material requires workshops with proper ventilation and extraction systems |
| Concerning hard material: Working on the material with simple hand tools is often laborious |
| Requires expensive and maintenance-intensive machines for easier processing |
| Different metals and their chemical properties demand extensive expertise |
| Machines and tools can be dangerous without proper training |

# HUMAN RELATIONS

( Human relations to the material )

A material is more than just its physical properties; when engaged with by humans, it can evoke emotions, memories, and associations — an important dimension that fosters greater respect and empathy for the material. We asked the designer what emotions and associations the material evokes in them—whether through working with it or simply thinking about it.

## Associations

Connection to traditional craftsmanship - metalworking can link to heritage and artisanal traditions, creating a sense of nostalgia or pride

Satisfaction of accuracy – metalwork often requires careful measuring, cutting, and joining etc., which can create a deep sense of focus and meditative concentration

## Emotions

Archaic and empowering - this is especially what working with fire and welding does

Sense of mastery – shaping or welding metal can help create a feeling of control over a tough and rigid material

# ROLE IN A CIRCULAR AGENDA

( The material's role in a circular agenda )

Each material has unique properties that determines its suitability for different contexts. Understanding these characteristics is crucial for applying materials effectively to support a circular agenda. Metal can contribute due to the following:

- → Metal has high recycling rates: Metal, especially steel, is almost 100 pct. recyclable. Aluminum and copper have a recycling rate of approximately 75 pct. with potential for improvement
- → Scrap metal can be repurposed, reducing the demand for virgin material
- → Metal has a long lifespan that can contribute to sustainable product design
- → Repair culture revival aspect: Makerspaces are fostering a repair culture by encouraging the repair of products like cooking pots and lawnmowers
- → Upcycling and safety concerns · Upcycling metals can be resourceful but is also creating dust and potential health hazards, which sometimes would make recycling a more sustainable option
- → Waste management improvements · Recycling of harmful chemical waste from metal processing is already in place e.g. with strict wastewater disposal regulations in some European countries
- → Economic incentive since scrap yards and workshops benefit from separating and selling metal waste as it has monetary value
- → Energy and cost efficiency since recycling metals, particularly aluminum, saves energy

## THIS MATERIAL IS AMAZING BECAUSE

"My professor, metal artist Herbert Gsöllpointer, once stressed that working creatively in the third dimension brings you close to what can be described as divine. I believe that the ability to shape one's environment has a great influence on one's personality. Among materials, metal offers some of the most expansive possibilities."

Tatjana Aranka Schinko

## WE NEED TO RESPECT THIS MATERIAL BECAUSE

"Metal has been a cornerstone of human progress, shaping both our past and modern society. Without it, we would never have moved beyond the Stone Age, and many of our most significant innovations — such as computers — would not have been possible."

Tatjana Aranka Schinko

# TOOLS

( Tools & procedures )

By highlighting a list of relevant tools as well as care and maintenance procedures that can be applied when working with the material, you gain an overview of how to start working with the material and how to take care of it - preferably on an ongoing basis - aiming to extend the lives of the products and materials.

Tools · Machines · Procedures

( Non-cutting manufacturing processes )

Casting

Forming

( Cutting manufacturing processes )

Cutting

Sawing

Drilling

Countersinking

Grinding

Turning

Milling

( Joining )

Gluing

Soldering

Welding

Screwing

Riveting

# TOOLS

It is generally recommended to use a makerspace equipped with a metal workshop. However, Tatjana also mentions, that if you plan to set up your own workshop (e.g. in your garage), the following tools and machines are the essential minimum.

Tools · Machines

( Minimum tools and machines for setting up your own workshop )

| |
|---|
| Sturdy table with vice |
| Angle grinder with various cutting and grinding media |
| Drill with HSS (high-speed steel) drill bit set |
| Drilling oil |
| Countersink |
| Thread cutting tool |
| Ruler and pencil or scriber |
| Stop square |
| Punch |
| Hammer |
| Screwdriver and wrench |
| Pliers |
| Personal protective equipment |
| Scrap box |
| Vacuum cleaner |
| Cleaning cloths |

# TOOLS



Care · Maintenance

Apply oil regularly to metal surfaces to prevent rust and corrosion, especially for tools, machinery, and outdoor structures. The type of oil you should use depends on the specific metal and its application. Some examples from the more sustainable category are mineral oil, linseed oil and tung oil

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Use grease on moving parts like hinges, gears, and other moving components to reduce friction, ensure a more smooth operation, and  contribute to extending the lifespan

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Clean the products by wiping the surfaces to remove dirt, dust, and moisture which potentially can contribute to wear and corrosion of the material

---

Inspect for damage by regularly checking for signs of wear, rust, or cracks, and try to address identified issues early on to prevent further deterioration

---

Repair when necessary by fixing minor damages such as dents, scratches, or loose parts to maintain functionality and durability of the metal

---

Make sure to store the metal properly - preferably in a dry environment - and use protective coatings or covers when necessary to minimise exposure to moisture, air and different metal alloys (i.e. do not put stainless steel beside steel as it starts to rust)

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# CON-STRAINTS

( Creative constraints & attention points )

A creative constraint is any circumstance or condition that limits creative options in some way. Setting limitations is essential, as it can both foster greater creativity and encourage consideration of nature and the environment early in product development.

The designer has shared their suggestions for creative constraints that could be integrated into practice when working with this material category.

## Suggested constraints

Use what you have - think of using leftover material instead of buying new one. Maybe you have some parts in your recycling container or visit your local junkyard. Considering this firstly before designing your project

Select locally sourced metals to reduce transportation emissions by choosing regional suppliers

Avoid using metals with high environmental costs (e.g. alluminium), if it is not 100 pct. necessary

Designing for disassembly by ensuring that metal parts can be separated easily for repair, reuse, or recycling

Optimisation of designs aiming to use less metal without compromising strength (e.g. through lightweighting or structural efficiency)

Choosing processing techniques that generate as little scrap as possible

Ensuring that designs can be fully recycled without material downgrading e.g. by avoiding mixed material bonding which makes recycling more difficult

# CON-
# STRAINTS

To work sustainably and responsibly with the material, it is essential to consider key attention points in its use.

## Attention points

Safety in machining is crucial. Understand proper handling techniques, as working with metal can pose risks. It is important to consider personal protective equipment like appropriate hand protection if necessary, safety glasses, steel-capped shoes, fire-proof, tight-fitting clothing, etc. is absolutely necessary

Be aware of chemical reactions as some metals release hazardous fumes when processed—burning zinc and chromium, for example, are dangerous to inhale

Fire hazards - avoid leaving oily rags exposed to air, as they can spontaneously ignite

Make sure you choose the right type of metal for your product. The type of metal you select is just as crucial as the machining process used to shape it

When setting up a workshop, it is essential to consider the material cycle and develop a functioning recycling system (collect scrap and auxiliary materials separately in suitable containers and develop a proper disposal plan with a disposal system)

Ground-floor workshops and warehouses are preferable due to the high weight of the material

Do not pour chemical liquids and micro plastic dust down the drain

# ADVICE

Discover expert advice from designers on working with each material — whether you are looking to deepen your understanding or start prototyping.

## The maker's best advice

Make sure to have someone in your circle who works professionally with metal

Sketch your idea – identify the most important properties before choosing a material

Choose the right metal as different metals have different properties and uses

Create a functional disposal system in your workshop (different containers for the various alloys and chemical waste), so the waste can be recycled and reused easily

## Start getting to know the material

There are countless forums and YouTube videos on the subject of metalworking. Find your personal influencer who can explain the subject to you in a simple way and possibly in your native language

Many makerspaces offer metal courses for beginners. A good idea is to take part in these and remember to ask questions.

Candlesticks are a great project to start with. You usually do not have to work particularly precisely and you can adapt the shape of the design to which machines and tools you have at your disposal. You can also make the candlestick with hand tools and screw connections. In the process, you will learn a lot of the peculiarities of the metal material

## When prototyping with the material, think about the following

Start by sketching your idea and draw your concept where you make sure to identify its key properties

Make a cutting plan before starting to work. This ensures that you do not waste material. You can find software online which counts out which parts should be cut out firstly

Remember to be sure that you select the right material. Consider which material best suits your design. If metal turns out to be the best choice, seek guidance from an expert

Before you make something out of metal, see if you can build an initial prototype out of another material first (e.g. cardboard) to test e.g. dimensions, impressions and the possible properties

Recommendation 01

# EXPERIMENTAL UTOPIA

The “Experimental Utopia” co-founded by Tatjana Aranka Schinko, is a collective that travels through cities with its bright pink, multifunctional bicycle trailer, spontaneously popping up in public places and causing a complete stir in public order.

The artists want to save the world in this way, as they say themselves. To do so, they use strange-looking strategies. For example, they play children’s games such as temple and rubber skipping, rope skipping or XO. Sometimes they even unpack their karaoke machine in broad daylight, sing out of tune and dance to it.

This attracts the attention of passers-by who stop and look interested. They come closer and make contact with the artists, start to play, and eventually interact with others. Temporary play groups are formed. The participants thus cross the invisible boundaries that lie between them and immerse themselves in other, initially still foreign worlds. In the process, their worldview and with it their city are transformed.

Learn more →

Web

Photo credit · Experimental Utopia

Chapter 05

# PAPER

Photo credit · studio circOlar

MATERIAL INSIGHTS · PAPER

"When we imagine paper today, we think of a white, flat sheet, which can be folded, torn, stained, and disposed of. But paper can be so much beyond a prefigured communicator, it's an object itself."

Kehong Song

# CONTRI-BUTORS

The main contributor of Chapter 5 · Paper is presented below.
The designer has provided us with knowledge, expertise, and perspectives concerning the material, allowing us to gain a unique insight into their work and personal relationship with the material category.

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( Kehong Song ) ( studio circOlar )

Kehong Song is the co-founder of studio circOlar - a material-driven design practice that connects architecture, design and art exploring the untapped potential of fiber waste. Studio circOlar critically embraces the as-found condition, repurposes the material, and inspires collective engagement.

Check Kehong out here → Web @studio_circolar

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# INTRO-
# DUCTION

( Introduction to the material category )

Each material category has a unique list of properties and their own way of being categorised and understood. We have asked the designers how they would categorise and explain the material category on an overall level.

The paper category represents the material that is lightweight, biodegradable, and easily printable which has several and diverse use applications.

---

( Categories of paper )

Graphic paper

Includes paper used for printing, writing and drawing.

Functions as a medium for communication and information sharing. This includes e.g. newsprint, office paper, magazines, and book paper.

Speciality paper

Paper that serves for specific purposes - such as toilet paper, filter paper, thermal paper (for receipts), and security paper (e.g. banknotes and passports).

Both paper types have the possibility to be made from recycled fibers or sourced from sustainably managed forests.

The paper type and production methods impact recyclability and environmental footprint.

# PROS & CONS

Pros

Every material has its advantages, making it valuable for different applications.
Below is a breakdown of the key pros for the material category.

Natural material

Affordable and available

Lightweight

Recyclable

Safe and easy to work with

No need for fancy equipment. Can simply be brought to a kitchen, be broken down into fibers and let the creativity begin

Working with paper is a tactile and tangible experience

Paper is versatile and flexible for diverse uses

Cons

At the same time, each material comes with challenges which should be considered.
Below is a breakdown of the main cons for the material category.

Paper takes some time to dry

Paper is not as robust as some other materials e.g. like plastic

Paper takes up a lot of space for storage, and is difficult for transport

# HUMAN RELATIONS

( A human's relation to the material )

A material is more than just its physical properties; when engaged with by humans, it can evoke emotions, memories, and associations — an important dimension that fosters greater respect and empathy for the material. We asked the designers what emotions and associations the material evokes in them — whether through working with it or simply thinking about it.

## Associations

Paper can bring up associations with and feelings of nostalgia

It can remind us of stories and the traces that it carries

Paper can help us bring back memories of the analogue era

It is linked to traditions

## Emotions

Crafting paper is calming, and even meditative. The techniques are simple but require practice where you immerse yourself in the process, listening to the tools and properties in paper - it is a way of reconnecting ourselves with the material

# ROLE IN A CIRCULAR AGENDA

( The material's role in a circular agenda )

Each material has unique properties that determine its suitability for different contexts. Understanding these characteristics is crucial for applying materials effectively to support a circular agenda. Paper can contribute due to the following:

- → Can be recycled multiple times, reducing the need for virgin pulp
- → It is compostable and biodegradable, meaning that it breaks down naturally when free from coatings and additives.
- → Can be produced from responsibly managed FSC or PEFC-certified forests or alternative fibers (e.g. bamboo, hemp, agricultural waste), reducing pressure on forests
- → Paper-based packaging and products can potentially replace plastics, helping reduce pollution
- → Supporting upcycling and reuse as it can be repurposed into new products and materials (e.g. furniture, décor, repurposed newspapers etc.)
- → Decentralizing recycling and enhancing local production can help us move away from centralized, international operations that make reuse of paper more accessible and can help empower communities
- → Involving people in recycling and paper-based production fosters collective engagement and responsibility and promotes sustainable behavior
- → Paper can be used for product design, interior furnishings, and durable applications, extending its lifecycle beyond single-use. There is a functional potential in paper that has not been explored to a great extent yet
- → Recycled paper objects showcase the beauty of repurposed materials, influencing consumer perception and encouraging sustainable choices
- → Recycled paper in familiar spaces can redirect desire, redefine comfort, and strengthen human-object relationships and thereby contribute to shifting consumer perceptions

## THIS MATERIAL IS AMAZING BECAUSE

"When we imagine paper today, we think of a white, flat sheet, which can be folded, torn, stained, and disposed of. But paper can be so much beyond a prefigured communicator, it's an object itself."

Kehong Song

## WE NEED TO RESPECT THIS MATERIAL BECAUSE

"Paper is often seen as one of the most recyclable materials, yet it can only be downcycled into cardboard or newspaper up to seven times — if properly sorted. In today's highly centralized recycling and mass production systems, paper waste undergoes intensive processing, including cleaning, de-inking, bleaching, and mixing with virgin fibers — practices that contribute to water pollution and high energy consumption.
We design paper for easy writing, treating fibers with coatings and colors, but in doing so, we reduce it to a flat medium that carries only prefigured information — overlooking its inherent beauty and material narratives. It's time to rethink paper, not just as a disposable surface but as a material rich with potential, redefining our relationship with both paper and the technologies that shape it."

Kehong Song

# TOOLS

( Tools & procedures )

By highlighting a list of relevant tools as well as care and maintenance procedures that can be applied when working with the material, you gain an overview of how to start working with the material and how to take care of it - preferably on an ongoing basis - aiming to extend the lives of the products and materials.

Tools · Machines · Procedures

( For paper handcrafting )

Paper pulp can be worked with freehand - just like ceramics

It is also possible to use a mold to form the paper pulp, where sheets can be drained and formed (a press machine is recommended)

Cutting tools like precision knives and scissors to help shape paper

Rolling pin or brayer can help flatten paper sheets and remove excess water

Sponges and towels can help absorb moisture, when forming and drying handmade paper

Press or heavy boards can be used to flatten and smooth handmade paper as it dries

Drying racks or a press can help ensure even drying and prevents warping

( Machines )

Laser cutter or die cutter – Provides precise cutting and shaping for paper products

3D-printing with paper pulp is also possible - used to make e.g. packaging, trays, furniture etc.

A blender or a hand mixer can help break down paper into fine pulp for small-scale production

Paper shredder can help speed up the process of breaking down paper into pulp

# TOOLS

## Care · Maintenance

Avoid excessive exposure to sunlight to prevent discoloration and brittleness

Avoid placing near heat sources (e.g., radiators, ovens) to prevent products from drying out and cracking

Avoid excessive exposure to moisture - keep products in dry environments to prevent softening, warping, or mold growth

It is possible to apply a protective coating (e.g., wax, natural resin, eco-friendly sealants) to increase water resistance

If a paper product gets wet, air dry it immediately in a well-ventilated space

Handle the products with clean, dry hands to avoid stains and weakening of the material

Avoid excessive bending or pressure, as paper pulp can crack or lose its shape over time

If a crack or tear appears, reinforce with paper-based glue or a thin layer of pulp to repair it

Use a soft, dry cloth or a gentle brush to remove dust

For stubborn dirt, lightly wipe with a damp cloth (avoid soaking the area)

Avoid harsh cleaning agents that could weaken the fibers

If no longer needed, repurpose or upcycle the product (e.g., turn it into new pulp or use it in craft projects)

Ensure proper disposal in composting or paper recycling streams if untreated with non-biodegradable coatings

# CON-
# STRAINTS

( Creative contraints & attention points )

A creative constraint is any circumstance or condition that limits creative options in some way. Setting limitations is essential, as it can both foster greater creativity and encourage consideration of nature and the environment early in product development.

The designer has shared their suggestions for creative constraints that could be integrated into practice when working with this material category.

## Suggested constraints

- Only source locally
- No bleaching and inking of the paper
- Use natural adhesives and dyes instead of synthetic alternatives
- Choose low-energy drying and forming methods such as air-drying over industrial heating
- Only use recycled paper or alternative fibers (e.g. agricultural waste, bamboo, hemp etc.)
- Avoid mixing materials that make recycling harder (e.g., coatings, plastics, or synthetic additives)
- Design products with simple, material-efficient forms to minimize waste during cutting or molding
- Use modular components to create adaptable and upgradable designs
- Limit water-intensive processes in production (e.g., use dry-press techniques where possible)
- Incorporate modular or foldable elements to extend usability before disposal

# CON-
# STRAINTS

To work sustainably and responsibly with the material,
it is essential to consider key attention points in its use.

Attention points

Use it for purposes that fits in its properties.

Balance durability with planned biodegradability—ensure long-lasting use but easy breakdown at end-of-life

Consider coatings or reinforcements that extend lifespan without compromising recyclability

When working with paper pulp, avoid glossy, laminated, or coated papers, as they may contain plastics or chemicals that hinder recycling.

Do your best to control the water-to-pulp ratio—too much water weakens the structure, while too little can make forming difficult

Thicker pulp layers take longer to dry and may crack—build in thin, even layers for better results

PROJECT INSIGHT

"We experienced a lack of transparent statistics when it comes to paper recycling and the paper manufacturing industry.

We still feel that paper is an overlooked field with less research and attention, which results in the lack of innovative technologies, methods and knowledge of working with paper."

Song Kehong · studio circOlar

# ADVICE

Discover expert advice from designers on working with each material — whether you are looking to deepen your understanding or start prototyping.

## The maker's best advice

Respect the properties of paper, prioritise the agency of paper, instead of forcing functions on it e.g. by adding other materials that cannot be decomposed or recycled again with paper

## Start getting to know the material

Start with youtube videos. There are a lot of youtube videos introducing and sharing their home projects with paper. You will have an overview of paper properties once you start making something simple - paper is not complicated at all

## When prototyping with the material, think about the following

Embrace imperfections - When first working with paper, you might experience troubles such as uneven surface, the inconsistent thickness, non-conforming colors, and fragile fibers. It is therefore important to keep in mind that it is important to work on how to embrace the imperfections since the "troubles" are also the aesthetics and authentic presentations of paper

Select and invent your own tools and methods to work with the "troubles"

Test the load-bearing capacity if creating structural products like furniture or packaging

Recommendation 01

# PULPSCAPE 2 STOOLS

Pulp-scape by studio circOlar is a series of projects transforming paper waste into new materials for creative use. It aims to revolutionise our perception of paper, transforming it  from an ephemeral resource that are typically downcycled, to a tactile  material that one can connect with.

With two stools, studio circOlar experimented with paper pulp's material potential in making furniture as a solid shape, showcasing the effect of paper pulp beyond the perception of a functional white sheet.

In the process, they prioritised knowledge accessibility and the importance of local collective creation at every step. They designed the mould as a wooden frame with changeable 3D-printed parts, encouraging different possible forms of a stool. The frame and changeable parts can easily be reproduced in a local makerspace.

Learn more →

Web

@studio_circolar

Chapter 06

# PLASTICS

Photo credit · Fantoplast

MATERIAL INSIGHTS · PLASTICS

“Plastics provide the change to create unique colour patterns - each piece has its own storytelling that brings waste back to life”

Irena Übler

# CONTRI-BUTORS

Each of the contributors of Chapter 6 · Plastics are presented below.
The designers have provided us with knowledge, expertise, and perspectives concerning the material, allowing us to gain a unique insight into their work and personal relationship with the material category.

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( Irena Übler ) ( PRIMA MATTERS )

Irena Übler is a product and furniture designer based in Porto, Portugal.
Irena creates unique design solutions for products, raising awareness of sustainable materials and exploring urban territories and creative culture with design.

Check Irena out here → Web @prima_matters

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( Max Scheidl ) ( FANTOPLAST )

Max Scheidl is a designer and co-founder of FANTOPLAST, an Austrian company turning local plastic waste into sustainable, high-quality panels for design and architecture. Committed to circularity and innovation, he helps reshape recycling's role in material production.

Check Max out here → Web @fantoplast

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# INTRO-DUCTION

( Introduction to the material category )

Each material category has a unique list of properties and their own way of being categorised and understood. We have asked the designers how they would categorise and explain the material category on an overall level.

(Synthetic) plastics are derived from crude oil, gas or coal and are known for being a lightweight, durable and moldable material that can be turned into complex shapes. Plastics are available in various forms with diverse chemical compositions for specific applications.

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( Categories of plastics )

There are two main groups of plastics: thermosets and thermoplastics.

Thermoplastics can be reheated and remelted, while thermosets cannot be remelted once set.

Thermoplastics (possible to reheat and remelt) · the 7 main types:

1. PET (Polyethylene Terephthalate) - Lightweight, strong, transparent, and moisture-resistant. Common for beverage bottles and food packaging

2. HDPE (High-Density Polyethylene) - Stiff, durable, and resistant to chemicals and moisture. Used for detergent bottles, pipes, and grocery bags

3. PVC (Polyvinyl Chloride) - Strong, chemical-resistant, and versatile. Used for pipes, flooring, and medical tubing (rigid and flexible forms)

4. LDPE (Low-Density Polyethylene) Flexible, lightweight, and moisture-resistant. Common in plastic wraps, squeeze bottles, and shopping bags

5. PP (Polypropylene) - Tough, heat-resistant, and lightweight. Used for food containers, automotive parts, and medical devices

6. PS (Polystyrene) - Lightweight and insulating but brittle. Found in disposable cups, packaging, and insulation materials

7. Others - a mix of various plastics like ABS, nylon, polycarbonates and bioplastics etc.

Thermosets (not possible to remelt) · some examples:

- Epoxy - highly elastic, tough and resistant to many chemicals
- Silicone - very high temperature resistance, great elastic, flexible and insulation properties
- PU (polyurethane) - highly resistant to wear and tear, thermal barrier
- Phenolic - highly flame resistant and high mechanical strength

# PROS & CONS

Pros

Every material has its advantages, making it valuable for different applications.
Below is a breakdown of the key pros for the material category.

Versatile and lightweight - can be molded into almost any shape and used across industries

Durable and strong - resistant to impact, moisture, and many chemicals

Resistance to wear and degradation

Hygienic properties

Easy to work with

Cost-effective - inexpensive to produce compared to many natural materials

Can be mass-produced with low energy compared to some alternatives

The many variations of plastics provides a wide range of properties
– meaning it can be flexible, rigid, transparent, heat-resistant, etc.

Some plastics can in theory be recycled multiple times

# PROS & CONS

Cons

At the same time, each material comes with challenges which should be considered. Below is a breakdown of the main cons for the material category.

Most plastics rely on petroleum to be produced, contributing to carbon emissions and extraction of finite resources

Non-biodegradable plastics contribute to waste and microplastic pollution of the environment

Recycling is often difficult as many plastics are not easily recyclable due to mixed materials or contamination

Some plastics release harmful chemicals over time - especially when heated

Incineration of plastic releases pollutants, and landfill disposal of plastic leads to long-lasting waste and pollution

Many plastics degrade in quality when recycled, limiting reuse potential (this is therefore downcycling and not recycling)

Working with 100 pct. recycled materials can be challenging, because there are slight differences in the physical properties depending on the source

There is often a lack of proper identification on items. This makes it difficult to determine which type of plastic it is. This is especially frustrating since accurate sorting is crucial for successful recycling and material quality

The process of recycling plastics from household waste can be very time-consuming. Before using the material, it requires extensive preparation, including cleaning, sorting by type and color, and shredding. These steps are essential but tend to delay the actual recycling process

The need for adequate storage space to collect and organize plastic waste efficiently. Storing materials by type and color in sufficient quantities is necessary for consistent recycling, but this requires significant room and planning

PROJECT INSIGHT

"Working with 100 pct. recycled plastic is always more challenging than working with virgin plastic. Recycled materials can be less predictable, and issues like air bubbles frequently arise. These bubbles can be frustrating, especially when they affect later processes such as CNC milling or finishing, where smoothness and precision are critical. While these challenges don't overshadow the potential of recycled plastic, they highlight the effort and care required to turn waste into unique valuable material. The storytelling aspect and the ability to give waste a second life makes it truly remarkable."

Irena Übler

# HUMAN RELATIONS

( Human relations to the material )

A material is more than just its physical properties; when engaged with by humans, it can evoke emotions, memories, and associations—an important dimension that fosters greater respect and empathy for the material. We asked the designers what emotions and associations the material evokes in them — whether through working with it or simply thinking about it.

## Associations

The satisfaction and joy of showing solutions with plastics and emphasise its potential for recycling - especially with the right systems in place.

The workshops on recycled plastic are aimed at spreading awareness about the low rate of plastic recycling and the issues that arise from this.

## Emotions

A sense of purpose - working actively on a global problem

A tingling sensation of touch

# ROLE IN A CIRCULAR AGENDA

( The material's role in a circular agenda )

Each material has unique properties that determine its suitability for different contexts. Understanding these characteristics is crucial for applying materials effectively to support a circular agenda. Plastics can contribute due to the following:

- → Potential for recycling if properly sorted and managed, although infrastructure varies
- → Bio-based and biodegradable plastics can offer more eco-friendly alternatives
- → Upcycling plastic waste into new products can extend material life
- → With well-designed products and production, plastics can be remelted and reprocessed up to approximately 10 times
- → Managing plastic waste responsibly helps reduce emissions by preventing incineration and landfill disposal
- → While plastic's durability and adaptability are invaluable, responsible use is key to maximising its potential in sustainable, long-term applications

## THIS MATERIAL IS AMAZING BECAUSE

"Plastics provide the change to create unique colour patterns - each piece has its own storytelling that brings waste back to life"

Irena Übler · PRIMA MATTERS

## WE NEED TO RESPECT THIS MATERIAL BECAUSE

"When working with plastic waste, it's something that we have already created. We need to deal with the context that we have created for ourselves."

Max Scheidl · FANTOPLAST

"Plastic can last up to 500 years. Despite only a small fraction being recycled, plastic pollution remains a massive and often downplayed issue fueled by demand for disposable products. Treating recycled plastic responsibly helps challenge wasteful systems, raise awareness, and promote sustainable, circular solutions."

Irena Übler · PRIMA MATTERS

"Plastic in general is a long lasting material - so if used as a high quality material, it can find sensible sustainable applications."

Max Scheidl · FANTOPLAST

# TOOLS

( Tools & procedures )

By highlighting a list of relevant tools as well as care and maintenance procedures that can be applied when working with the material, you gain an overview of how to start working with the material and how to take care of it - preferably on an ongoing basis - aiming to extend the lives of the products and materials.

Tools · Machines · Procedures

## ( Cutting and shaping )

Circular saw

Jig saw

Water jet cutter

Drills and Screwdrivers: Essential for assembling plastic components using screws or bolts

CNC router/mill - excellent for cutting, shaping and engraving recycled plastic blocks or sheets. Useful for creating complex designs or prototypes

Woodworking tools (table saw/band saw) - useful for cutting larger plastic sheets or blocks into managable sizes

NB! Laser cutter is not recommended since it burns plastic, creating toxic fumes that harm both the environment and the laser cutter itself

## ( Forming and moulding )

3D-printer

Shredder - essential for breaking down larger plastic pieces into smaller flakes, which can then be melted or processed

Injection Molding Machine - Allows for the creation of detailed parts by injecting melted plastic into molds. Precious Plastic machines are perfect for small-scale applications

Extrusion Machine - Converts shredded plastic into filament to be shaped manually (requires practice for precision) or extrudes into simple molds like beams or other forms with thicker walls

Compression Molding - Uses heat and pressure to form melted plastic into desired shapes. This is great for flat items or designs with simple geometry, like plastic boards for building objects

# TOOLS

( Finishing )

Sanding and polishing (any type, by hand)

Sanding tools / polishing machines are not recommended as they generate microplastic d ust that is hard to recycle and can easily pollute the environment

Printing onto the materials as a manipulation / add-on

( Assembly and fastening )

It can sometimes be hard to connect pieces. Solid connections work better than screws as they loosen up over time. Glueing between plastics or other materials is not recommended because this cannot guarantee later recycling process

## Care · Maintenance

Avoid big temperature jumps as it creates stress in the material.
Keep away from extreme heat or cold

Clean regularly - use mild soap, water, and a soft cloth

Avoid abrasives or harsh chemicals

UV Protection - store indoors or in shade. Apply UV-protective coating for outdoor items

Handle Gently - avoid impacts, sharp objects, and heavy loads

Repair and repurpose - fix minor damage or recycle when needed

Educate Users - share care instructions for communal use

Avoid using acetone, as it can slightly dissolve the surface. If you want to refresh the surface, use silicone oil instead. Be sure to clean it thoroughly after application to prevent stickiness.

# CON-STRAINTS

( Creative contraints & attention points )

A creative constraint is any circumstance or condition that limits creative options in some way. Setting limitations is essential, as it can both foster greater creativity and encourage consideration of nature and the environment early in product development.

The designers have shared their suggestions for creative constraints that could be integrated into practice when working with this material category.

## Suggested constraints

- Regional and local sourcing of the material
- Working to the highest level of purity (using only one type of plastic)
- Communicating ways to use our material in a circular manner to our clients (not using glue, etc)
- No application of glue
- No waste should come from leftover production
- Do not mix different types of plastics to ensure optimal results and maintain the possibility of recycling them in the future

# CON-
# STRAINTS

To work sustainably and responsibly with the material, it is essential to consider key attention points in its use.

## Attention points

Its widespread use in disposable and single-use items contradicts its true strengths and potential, leading to significant environmental challenges

Design objects of plastic with a long life and good quality to avoid creating more waste in the future

Consider how you can contribute to innovations that make recycling more accessible and efficient

Focus on how you can contribute to reducing plastic waste in the first place

Avoid mixing different types of plastic to maintain material quality and ensure recyclability at the product's end-of-life stage

When recycling plastic, be mindful of unknown additives such as flame retardants or dyes, which can impact the process and pose health risks. Careful sourcing, precise sorting, and contaminant testing help ensure safe and effective recycling.

PROJECT INSIGHT

"Thoughtful Product Design: Focus on designing products that not only meet the client's functional and aesthetic needs but also consider their lifecycle impact. A well-designed product can inspire a shift in mindset, encouraging people to minimize waste and adopt more sustainable habits. This can include promoting practices such as buying local, choosing fewer but higher-quality products, and making decisions that challenge the overconsumption-driven logic of capitalism. By fostering conscious consumption, thoughtful design helps create meaningful products that align with sustainable values and reduce environmental impact."

Irena Übler

# ADVICE

Discover expert advice from designers on working with each material
— whether you are looking to deepen your understanding or start prototyping.

## The makers' best advice

Try to connect with local recyclers, as they often have an overview of local waste streams to some extent

Look for (nearby) plastic processing companies as they often have production waste

You can source plastic yourself (e.g. bottle caps or 3D-printed waste). This approach is especially good for quick small scale projects

## Start getting to know the material

Many makerspaces offer workshops in simple plastic projects and designs. Find your local makerspace and check out the opportunities

NB - Avoid working with plastic in your own home due to health concerns and risks

## When prototyping with the material, think about the following

Dry the plastic - if there is moisture inside the material and then heat it up, gas bubbles will occur. If it is being dried, it is way easier to process

Start by prototyping with cardboard or other leftover materials

Test material samples - make smaller versions to get an idea about visual appearance and finishing

Produce a metal mold only if it is intended to produce more than 100 units

Know the source – the more you understand about the source of the plastic waste being processed, the better you'll be able to determine how to process it and identify the most suitable applications. For example, some products may require additives that provide UV resistance; knowing this would make outdoor products from this waste stream a more logical choice.

Recommendation 01

# FANTOPLAST

FANTOPLAST makes high-quality panels that are produced in various thicknesses and patterns using 100 pct. locally sourced, recycled, and recyclable plastic waste. Manufactured with green energy in Vienna's Seestadt district, they offer a sustainable solution for design and architecture. The panels can be used in furniture construction, interior design, wall cladding, and both indoor and outdoor applications - including wet areas and DIY projects. The panels are easy to work with by using standard hand tools such as circular saws and routers as well as CNC milling and water jet cutting.

Through a holistic design and production process, FANTOPLAST transforms regional plastic waste into aesthetically refined, high-quality, and versatile panels. This is made possible through collaborations with experienced regional partners in research and the circular economy. At the end of their lifecycle, the panels can be refurbished or recycled, contributing to a closed-loop system.

FANTOPLAST is driven by a passionate, multidisciplinary team that bridges design, research, art, and culture with the regional circular economy. They aim to revalue plastic as a circular resource, embracing its versatility and developing meaningful, durable solutions for its reuse.

Learn more →

Web

@fantoplast

Recommendation 02

# PRIMA MATTERS

Irena Übler is an independent product designer, maker, and material researcher, as well as the founder of PRIMA MATTERS—a project that bridges industry, design, and science in a sustainable way. The project focuses on rethinking material requirements by working with both natural raw materials and man-made waste. Through research and experimentation, PRIMA MATTERS explores new ways to use and reuse materials in an environmentally responsible manner, with a particular focus on local waste streams such as cork, ceramics, paper, and plastic.

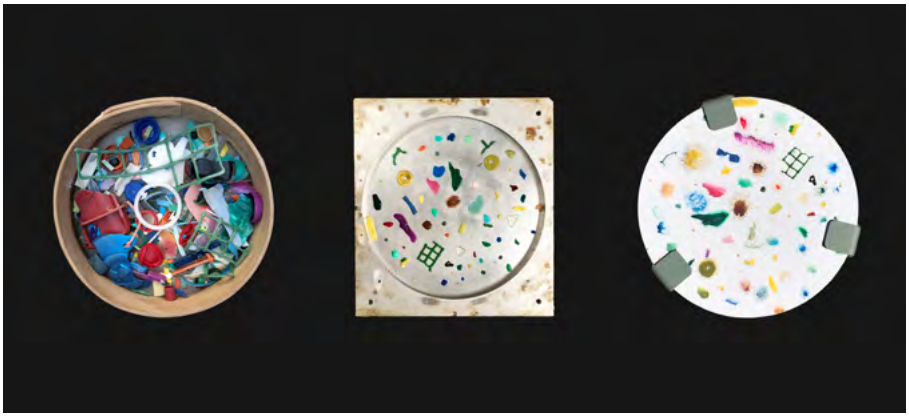
“With years of hands-on experience in plastic recycling as part of the Precious Plastic Portugal team, I began testing different types of plastics that are typically challenging for conventional recycling processes—from beach plastic to single-use laboratory equipment, as well as typical household waste and industrial byproducts.”

As part of PRIMA MATTERS, Irena has developed a material library showcasing a variety of plastics to explore their potential for 100 pct. recycling. By creating material sample tiles and analyzing their properties, the next step is to apply these recycled materials in product design—transforming waste into valuable, functional objects. Through design-driven solutions, PRIMA MATTERS raises awareness of sustainable materials while exploring the intersection of urban environments, creative culture, and material innovation.

PRIMA MATTERS was initially developed within the framework of the European Capital of Culture Aveiro 2027 bid book.

Learn more →

Web | @prima_matters | @preciousplasticportugal



Chapter 07

# TEXTILES

Photo credit · Karolina Grabowska on Unsplash

MATERIAL INSIGHTS · TEXTILES

“The best way to take care of textiles is to treat them as if you love them. Only keep what you love and stick to creating clothes you are sure you will love. If you don’t love it, you won‘t treat it well.”

Stephanie Edelhofer

# CONTRI-BUTORS

Each of the contributors of Chapter 7 · Textiles are presented below.
The designers have provided us with knowledge, expertise, and perspectives concerning the material, allowing us to gain a unique insight into their work and personal relationship with the material category.

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( Stephanie Edelhofer ) ( Happylab )

Stephanie Edelhofer, a trained clothing technician with a degree in Fashion & Technology, explores innovative fashion production methods. By using digital fabrication, she reimagines traditional textiles like lace to make them more accessible

Check Stephanie out here → Web @stephanie.edel

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( Virginia Rollando ) ( Simply Suzette )

Virginia is a sustainable fashion expert, researcher, and consultant. She has a wide range of experience working in factories in Asia and Europe, and is currently working with Cambridge University, Yunus Social Business, and Simply Suzette to implement improvements in supply chains, both socially and environmentally.

Check Virginia out here → Web @virginiaroll

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( Davide Balda ) ( Archeomaterico )

Davide Balda is a multidisciplinary designer who combines his different professional and educational backgrounds by developing the “ARCHEOMATERICO” research. This is a methodology aimed at addressing issues and problems related to the environment and today’s society, transforming and evolving them in concrete terms through the creation of new production processes and sustainable materials based on the use of waste resources.

Check Davide out here → Web @archeomaterico

# INTRO-
# DUCTION

( Introduction to the material category )

Each material category has a unique list of properties and their own way of being categorised and understood. We have asked the designers how they would categorise and explain the material category on an overall level.

The textile category represents a soft and flexible material that provides breathability, insulation, and aesthetic versatility.

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( Categories of textiles )

Natural Fibers

Derived from plants or animals, natural fibers come from fields or forests and have been used for centuries due to their breathability, biodegradability, and comfort. They can be woven or knitted into a variety of fabrics.

This category includes fabrics such as:

- Cotton – Soft, breathable, and widely used for clothing and home textiles
- Linen – Made from flax plant fibers, known for its durability and moisture-wicking properties
- Wool – Sourced from sheep, offering warmth and insulation
- Silk - Sourced from silk worms known for being lightweight, soft and smooth
- Leather - coming from animal skins, offering durability, versatility and water-resistancy
- Cashmere - sourced from the undercoat of cashmere goats is soft, delicate, warm and lightweight
- Bamboo coming from bamboo plant fibers is a breathable and moisture-wicking fabric
- Hemp - made from cannabis sative plant fibers is a durable and absorbent natural fabric
- Jute - made of jute plant stem fibers and is known for being strong, durable, and breathable

Synthetic Fibers

Man-made fibers produced through chemical processes, primarily derived from petroleum-based resources. These fibers are valued for their durability, elasticity, and resistance to wrinkles and shrinkage.

This category includes fabrics such as:

- Polyester – Strong, wrinkle-resistant fiber used in e.g. apparel and industrial applications
- Elastane (Spandex/Lycra) – Highly elastic and used in stretchable fabrics, such as activewear
- Nylon - Strong, lightweight, and moisture-resistant fiber often used in activewear, hosiery, and outdoor gear
- Acrylic - Soft fiber known for its warmth, often used in sweaters, blankets, and upholstery

# PROS & CONS

Pros

Every material has its advantages, making it valuable for different applications.
Below is a breakdown of the key pros for the material category. Here, they are divided into general pros, pros about synthetic fibers and pros about natural fibers.

Easy to cut, shape, and manipulate for various applications, from clothing to interior design

Typically easy to handle, transport, and store compared to other material categories

Affordable and available material

Can be dyed, printed, embroidered, or treated for specialized functions (e.g., water resistance)

Most types of textiles are washable

Repairs like stitching are relatively simple compared to other materials

Can be worn directly on the body

Synthetic fibers: Not necessary to be very cautious when washing synthetic fibers

Synthetic fibers: Easy to work with synthetic fibers as the processing is often straight-forward

Synthetic fibers: Ironing of synthetic fibers often not necessary

Natural fibers: Breathable as they have pores that allow for airflows and absorption

Natural fibers: Offers softness. Wool also becomes softer over time

Natural fibers: Especially silk and wool are long-lasting. By performing care and maintenance procedures over its lifetime, they have the potential to last for many years

Natural fibers: Comes from renewable resources and are thereby biodegradable in the end of their lives

Natural fibers: E.g. cotton and silk are less irritating for sensitive skin.
They also usually do not accumulate static electricity

# PROS & CONS

Cons

At the same time, each material comes with challenges which should be considered. Below is a breakdown of the main cons for the material category. They are divided into general cons, cons about synthetic fibers and cons about natural fibers.

Conventional textile production have a huge negative environmental impact

Zero waste when working with textiles is hard

The negative environmental impact of the predominant approach to textile consumption

Some fabrics use chemical dyes that prevent their use as a fertilizing substrate

Difficult to reuse fabrics composed of a mix of percentages of organic and synthetic fibers respectively

Transforming and reworking fabrics into fibers is a process that requires a lot of time, it would be necessary to rely on industrial technologies to process the material in less time

Increased complexity in handling the fabric arises from its varying properties, such as its ability to withstand different temperatures without shrinking or developing burn marks, its longevity in maintaining appearance, and the risks associated with wear and tear.

Synthetic fibers: Extraction of oil for synthetic fibers pollute, harms the environment and extract finite resources

Synthetic fibers: Release micro plastic during use

Synthetic fibers: Lack of breathability and can contribute to irritation of the skin

Synthetic fibers: Can accumulate static electricity

Natural fibers: Cotton fields take up land space

Natural fibers: Wrinkle more easily and may require ironing or steaming (especially linen and cotton)

Natural fibers: Can shrink when being washed in hot water or dried using high heat

Natural fibers: Absorbs liquids easily and are therefore more prone to being stained from spills, grease etc. which can be hard to remove if not treated correctly

Natural fibers: Provide food for mildew and mould growth (especially in damp environments) as well as for carpet beetles, clothes moths and certain insects

Natural fibers: Often more expensive than synthetic fibers

# HUMAN RELATIONS

( Human relations to the material )

A material is more than just its physical properties; when engaged with by humans, it can evoke emotions, memories, and associations—an important dimension that fosters greater respect and empathy for the material. We asked the designers what emotions and associations the material evokes in them—whether through working with it or simply thinking about it.

## Associations

Nature is always gifting us with magical solutions

The consistency of the textile fiber stimulates the sense of touch, evoking sensations linked to childhood

## Emotions

Amazement at the potential for products to grow and the vast knowledge that can be gained from natural fibers

Satisfaction in reducing environmental impact by repurposing waste materials, adding value to the design process, and enhancing a project's contribution to creating real-world change

# ROLE IN A CIRCULAR AGENDA

( The material's role in a circular agenda )

Each material has unique properties that determine its suitability for different contexts. Understanding these characteristics is crucial for applying materials effectively to support a circular agenda. Textiles can contribute due to the following:

- → Regenerative and organic farming – natural fibers can be cultivated by using sustainable practices that help restore soil health and can even have the potential to become climate-positive materials
- → Diverse applications – textile fibers have great potential beyond the fashion indsutry - it can contribute to various industries and sectors
- → Recycling and upcycling – initiatives that repurpose textiles can contribute to reduce waste and extend the lifespan of the materials
- → Bio-based and natural textiles like organic cotton and hemp can offer a lower environmental footprint compared to conventional alternatives
- → Encouraging practices like repair, resale and take-back systems can help support circularity by prolonging textile use and reducing resource consumption

# THIS MATERIAL IS AMAZING BECAUSE

"Natural textile materials can help support farmers and can be developed in harmony with nature in all the aspects of production. There are many methods for building resilient soils and we have our farmers to thank for that. Regenerative farming includes incorporating animals for grazing and natural fertilisers, building bio-diverse fields by planting trees, cover crops to conserve soil, rotating crops and boosting soil fertility with fungal compost. Finding solutions with natural textiles is an additional challenge but it can come with huge rewards."

Virginia Rollando

"My favorite textiles are the ones that are the most luxurious and old. It is likely that this was produced by perhaps the smallest animal involved in fiber production: the silkworm. Since the Neolithic period, silk has been obtained from the cocoons of these tiny creatures, which are traditionally boiled during the extraction process. Only recently, I learnt about a method of production that doesn't involve killing the animals - this is known as peace silk."

Stephanie Edelhofer

# THIS MATERIAL IS AMAZING BECAUSE

"The fiber regenerated from textile production waste is used to create new applications that connect the fashion industry to the agricultural sector, construction companies and interior design, helping to create a system that allows waste material to be used for new purposes within a different economic system.

For example, in the agricultural sector, vegetable and animal textile fiber can be a new tool to replace and preserve the use of natural resources used in systems for the germination of crops such as peat. The methods of extraction of this material are highly impactful and avoiding this process would help preserving biodiversity and the functions of the natural ecosystem. Fabrics and textile fiber have the ability to retain a lot of water, compared to soil, which means a great water saving and the possibility of growing crops and producing food even in periods of drought or places where water is not available."

Davide Balda

# WE NEED TO RESPECT THIS MATERIAL BECAUSE

"Natural materials have an element of magic, and we need to thank our beautiful nature for that. They give us warmth, strength, stretch, and resistance. By prioritising such materials and protecting soil health, growing fibres can help reverse the negative impacts of traditional fibre cultivation and help to protect biodiversity. Isn't that magical?"

Virginia Rollando

"I believe it's important to know where materials come from, how they're produced, who produces them, and at what cost. I think we need to either find ways to fully recycle the "bad" materials and justify their use, or consciously produce and consume the "good" materials."

Stephanie Edelhofer

"Discarded clothing and textile scraps are often seen as lifeless waste, but with the right transformation, they can take on new purpose. By shifting our perspective from product to material, we unlock their true potential — turning waste into a valuable resource rather than pollution. These reclaimed fabrics will be a key resource for future generations, reducing our dependence on raw materials and preserving natural ecosystems."

Davide Balda

# TOOLS

( Tools & procedures )

By highlighting a list of relevant tools as well as care and maintenance procedures that can be applied when working with the material, you gain an overview of how to start working with the material and how to take care of it - preferably on an ongoing basis - aiming to extend the lives of the products and materials.

Tools · Machines · Procedures

( Most basic tools )

Scissors – preferably fabric scissors that are sharp and designed to cut fabric

Pins and needles – used for securing fabric pieces before sewing

Thread and sewing needles – both for hand-sewing and machine sewing

Sewing machine – essential to speed up the stitching and creates more durable seams

Seam ripper – can help undo stitches and correct mistakes

Iron and ironing board – to press fabric and make it straight which makes it easier to work with

Measure band or ruler

Marking tools – chalk, fabric pens, or tailor's pencils for pattern markings

( Some add-ons that can help reaching different effects )

Embroidery – can be done by hand or by an embroidery machine

Dyeing – wide range of techniques exists. Prioritize natural dyeing (only works on natural fabrics)

Washing textiles with stones and abrasives make the textile softer

Laser cutter – enables encraving and cutting

( To break down the material )

Wheat mill

Coffee grinder

Shredders - can be combined with binders to make the textile into e.g. isolation and/or building materials

# TOOLS

Care · Maintenance

Wash with care by following care labels for temperature and washing recommendations. Wash with cold(er) water to preserve colors and fabric integrity

Prioritise using gentle detergents like mild, eco-friendly ones that are gentle o n fabrics and the environment

Whenever possible, air dry textiles to prevent damage from high heat in dryers, which can weaken fibers over time

Avoid hanging delicate textiles that might stretch and where the hangers will cause damage on the clothes

Do not wash textiles after every use unless necessary—this can help prevent unnecessary wear and tear. Try to clean spots on specific areas when possible

Iron textiles at the appropriate heat setting for the fabric to avoid burns or damage. Consider using steam for a more gentle option

Mend and repair small tears, loose threads, or missing buttons as early as possible to avoid increased significant damage

Prolong the color and fabric life by limiting prolonged exposure to direct sunlight, which can cause fading

Store fabrics properly (e.g., away from moisture or direct sunlight) and learn correct washing techniques for different textiles

PROJECT INSIGHT

"Reusing textile waste helps build circular economies by preventing discarded fabrics from becoming environmental and social hazards. Currently, large volumes of second-hand clothing are exported, particularly to Africa and South America. While half of these garments are resold in local markets, the rest—often low-quality or damaged—end up in illegal landfills, where they are burned, releasing harmful chemicals into the air and soil. To tackle these issues, a more sustainable approach is needed: 1. Transform textile waste into new raw materials – Repurposing discarded textiles reduces reliance on virgin resources, preventing further environmental degradation and preserving ecosystems. 2. Address waste at its source – Managing textile waste where it is produced prevents it from becoming a global burden, reducing pollution, protecting public health, and safeguarding local textile economies from collapse."

Davide Balda

# CON-STRAINTS

( Creative contraints & attention points )

A creative constraint is any circumstance or condition that limits creative options in some way. Setting limitations is essential, as it can both foster greater creativity and encourage consideration of nature and the environment early in product development.

The designers have shared their suggestions for creative constraints that could be integrated into practice when working with this material category.

## Suggested constraints

Avoid mixing fibers (e.g. organic with synthetic) to improve recyclability and enable easier material recovery

Limit - or even avoid - the use of additional materials like glue, coatings, or synthetic reinforcements that complicate recycling to the greatest extent possible

Prioritise to work with second-hand, deadstock, or leftover textiles from nearby suppliers to reduce waste and transportation emissions. Always be critical toward where the fabric originates from.

Work with low- or zero-waste pattern cutting, designing garments and textile products with minimal fabric waste. Explore innovative pattern-making techniques to achieve this.

Implement and experiment with low-tech or traditional crafting methods, tools and techniques to reduce reliance on resource-heavy production processes

Ensure textiles can be repaired or modified rather than discarded

Create textiles and products that easily can be separated into their base materials for better end-of-life processing

Limit the use of chemical dyes, coatings, and finishes that negatively impact recyclability or biodegradability

Prioritize sourcing, production, and distribution within a regional supply chain to reduce the carbon footprint

# CON-
# STRAINTS

To work sustainably and responsibly with the material, it is essential to consider key attention points in its use.

**Attention points**

Remember only to use what you need

Understand the differences between natural, synthetic, and blended fibers, as they affect durability, breathability, and sustainability etc.

Keep an eye on textile certifications e.g.:
- RCS and GRS (recycled),
- OCS and GOTS (organic)
- Fairtrade
- REGEN ORGANIC (ROC) (regenerative)
- Climate Beneficial

Use sharp fabric scissors or rotary cutters for precision and prevent fraying with pinking shears or edge finishes

Learn how to set up and use a sewing machine, choose the right needle for different fabrics, and practice simple stitching

Make sure to pre-wash and iron fabrics to prevent shrinkage and ensure accuracy in cutting and sewing

Plan pattern layouts carefully to minimize fabric waste, and save scraps for future use

Be aware of how fabrics behave (woven vs. knit) to avoid issues like stretching or puckering during sewing

Use pins carefully, handle sharp tools safely, and ensure proper ventilation when working with adhesives or dyes

Prioritize natural fibers, repurpose old fabrics, and avoid synthetic blends when possible

PROJECT INSIGHT

“We need to rethink how we produce and consume textiles, as the industry is one of the most polluting sectors. The focus should be on developing recycling systems, using renewable resources, upcycling materials, minimizing production waste, ensuring fair wages, promoting local production, and reducing toxic chemicals in dyeing and coloring.”

Stephanie Edelhofer

# ADVICE

Discover expert advice from designers on working with each material — whether you are looking to deepen your understanding or start prototyping.

## The makers' best advice

Think about and educate yourself on the whole process that helped creating the material. Think of the processing, the dyes, the packaging etc. involved. Not all materials in the same category are made in equal manners

Consider what you want to produce and why. Then, connect with people who do similar work and seek their expertise. Who knows more about wool than a shepherd? Who can knit better socks than my grandmother?

Contact textile companies that generate a significant amount of waste and contact organizations or cooperatives that deal with the disposal and reuse of waste

Engage with companies genuinely interested in repurposing textile waste

## Start getting to know the material

Practice basic techniques like hemming, patching, and reinforcing seams to extend the life of textiles

Start with simple patterns. You can e.g. start creating something simple like a tote bag or a pouch, but ensure that you are being mindful of what you really need

Another suggestion for a first project could be (quite traditionally) an old piece of clothing that is being transformed. Maybe a pair of trousers would look nicer as shorts, adding something to a pair of jeans would suddenly make them unique, or a leather jacket could be turned into a bag

## When prototyping with the material, think about the following

Consider the pattern that is being used and how much waste it will generate. Think about whether there could be better ways to cut things

Remember that all textiles behave differently. The same pattern can yield d ifferent results depending on the material (e.g. silk vs. denim)

Start with a small-scale prototype to minimize waste, whether making a t-shirt or a house

Assess the quantity and type of fabric available, including fiber origin

Recommendation 01

# TELARE LA MATERIA

TELARE LA MATERIA, sewing new bonds through textile waste.

Through a sustainable and innovative approach, Telare la Materia proposes a solution to improve the fashion supply chain with the aim of giving new value to unsold clothing and fabrics because they are defective. These products are reduced and re-transformed with a grinding process into both synthetic and organic textile fibres that become raw material to be reused in three different applications: Tecnosuolo, Building Material and Nuno Felt.

Tecnosuolo is the soil of the future that uses plant and animal textile fibres as a plant substrate and fertiliser for the germination of plants and as mulch with the aim of protecting plants from atmospheric phenomena and preserving soil humidity, improving its structure. Building Material is a green building material in which textile fiber is combined with clay residues or a geopolymer base to develop a natural plaster and tiles for internal use, with thermal and acoustic insulation characteristics, together with a brick that can be used in the construction sector. Nuno felt is a felt made with the wet felting technique, which consists of a manual massage with soap of synthetic and organic fibers. This felt can be used as a fabric to make clothing or to develop furnishing accessories and as thermal and acoustic insulation inside homes.

Learn more →

Web

@archeomaterico

Recommendation 02

# INTERLACED

Interlaced: Bridging Tradition and Technology in Fashion

This project explores the intersection of traditional textile crafts and digital technology, investigating how digital filters can deconstruct and transform traditional techniques. By combining scanning, photography, and digital manipulation, new patterns emerge, bridging the gap between handicrafts and the digital age. The project also experiments with alternative clothing production methods using laser-cutting technology available in makerspaces, allowing garments to be assembled without sewing machines, relying on hand-stitching instead. This approach aligns with the concept of open-source fashion, promoting local, social, and collaborative production as an alternative to mass-produced clothing.

The arrival of fashion in makerspaces challenges the consumer-driven fashion industry and proposes a more sustainable, community-driven model. It raises questions about the role of brands, the potential for currency-free fashion, and the impact of localized production. By leveraging digital manufacturing methods, fashion becomes more individualized, breaking free from industrial constraints and offering new creative possibilities. It considers the preservation of traditional techniques in a rapidly advancing technological landscape and explores how new manufacturing methods affect the value and identity of objects.

If clothing were to be produced locally and socially again, what effect would this have on the attribution of our clothing? Would brands still play a role? Can fashion be currency-free?

Learn more →

Web

@stephanie.edel

Recommendation 03

# SUPPLY CHAIN 101

This initiative is aimed at helping people understand the ins and outs of the fashion industry, targeting a broad spectrum of fashion items. It is a free and open source platform, where they aim to bring people together.

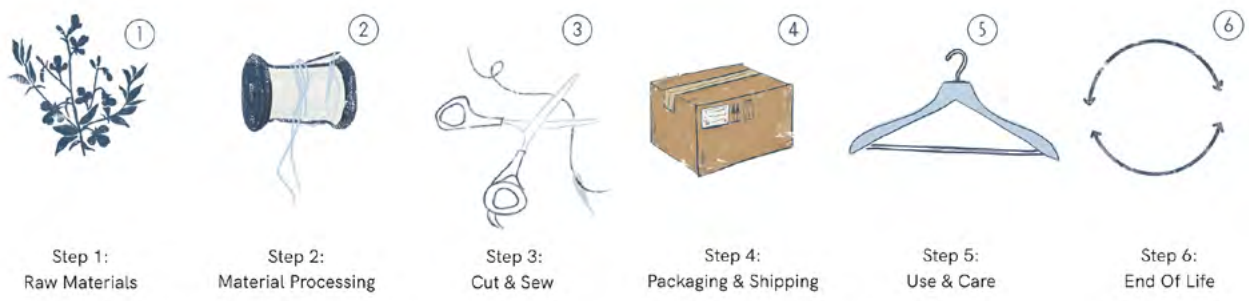
They initiate with the foundational principles of sustainability, pivotal throughout this guide, then progress through the supply chain stages—beginning at the source. They elaborate on a wide range of materials, and how these are transformed into fabrics, garments, sold products, and waste.

The objective with the initiative is to demystify supply chain mechanics, emphasizing the best practices at every production phase. They believe that if there were more knowledge about fashion supply chains, consumers, designers, and everyone who interacts with fashion in their lives would have better tools and prerequisites to make more sustainable choices.

The initiative starts by introducing some practices that are relevant across the entire supply chain and then dives into the specific steps that garments go through. The fashion industry has found ways to use almost all available materials and processes, continuously driving innovation. However, they hope the focus will shift toward implementing the many amazing solutions that are already widely available. On the same website, deep-dive articles on various projects can be found, including Virginia's recent research into Kenya's second hand and sustainable fashion industry.

Learn more →

Web



Chapter 08

# WOOD

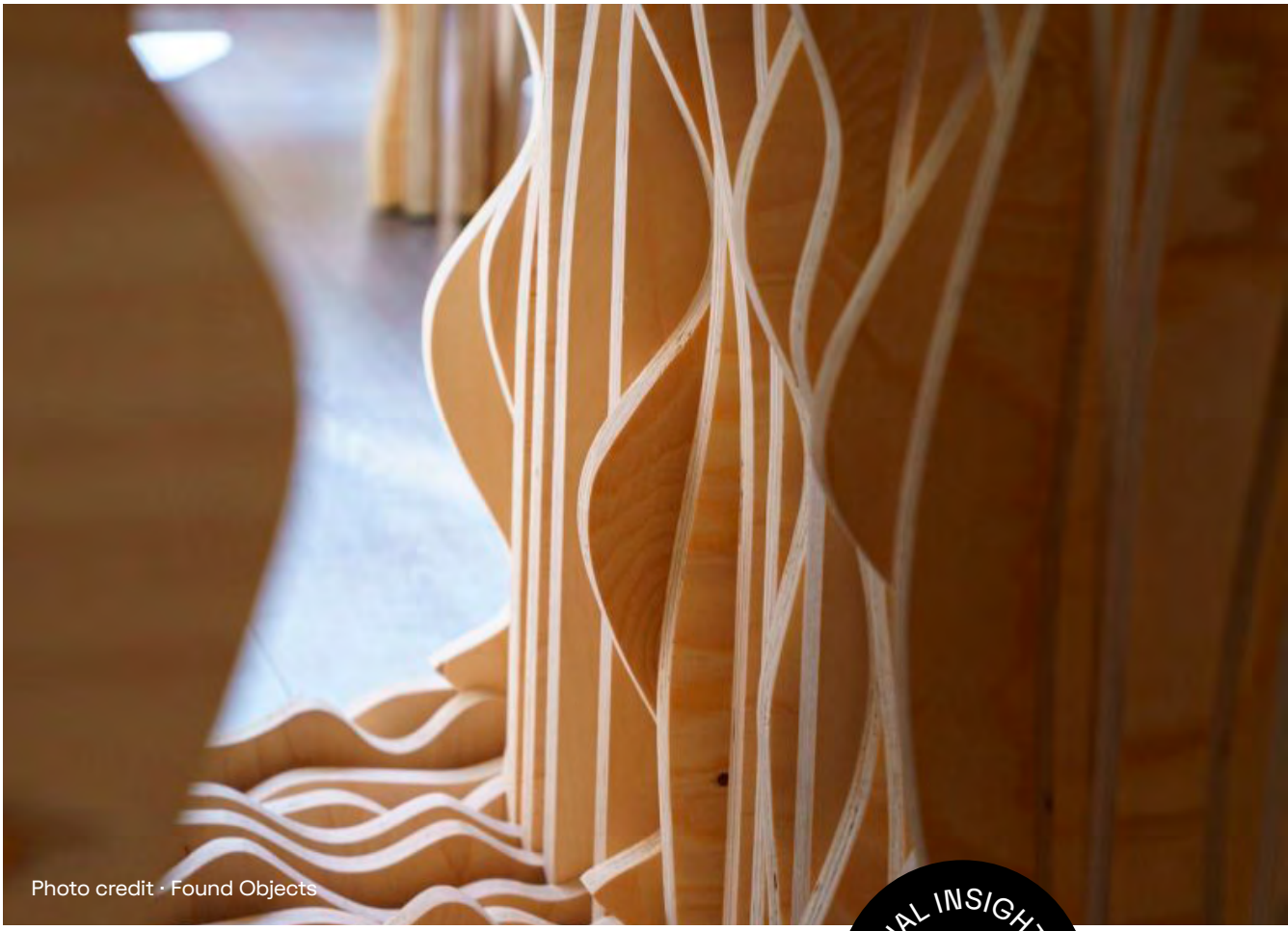


Photo credit · Found Objects

MATERIAL INSIGHTS · WOOD

"This material is a living being and deserves our respect. Just think about the fact that some boards are likely to be from trees that are older than yourself."

Mariana Costa e Silva

# CONTRI-
# BUTORS

Each of the contributors of Chapter 8 · Wood are presented below.
The designers have provided us with knowledge, expertise, and perspectives concerning the material, allowing us to gain a unique insight into their work and personal relationship with the material category.

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( Johannes Hoffmann )

Johannes Hoffmann is an artist and designer. After training as a carpenter, he studied at the Academy of Fine Arts in Vienna, where he has been teaching about wood since 2003.
His work includes urban furnishings, room designs and 1:1 implementations in public spaces.

Check him out here → Web

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( Mariana Costa e Silva ) ( FAZ com as tuas mãos )

Mariana Costa e Silva, a designer and trainer, created FAZ, a participatory manufacturing process. It encourages beginners to self-produce furniture and toys using common tools, local and biodegradable materials, offering a sustainable alternative to consumerism through short, accessible workshops.

Check it out here → Web Distributed Design Platform

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( Paola Zanchetta Muñoz ) ( Fiction Factory )

Paola Zanchetta is an Amsterdam-based distributed designer, maker, and researcher, driven to promote regenerative practices and awaken environmental awareness by working with waste materials in the open-source context.

Check it out here → Distributed Design Platform Found Objects

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# INTRO-
# DUCTION

( Introduction to the material category )

Each material category has a unique list of properties and their own way of being categorised and understood. We have asked the designers how they would categorise and explain the material category on an overall level.

Wood as a material category represents a natural, renewable, and biodegradable material with a warm, tactile aesthetic. Wood is strong yet lightweight with versatile applications in construction, furniture, and design. Wood even has the ability to absorb and store carbon throughout its life cycle.

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( Categories of wood )

1. Solid wood · Natural wood used with minimal processing:
— Softwood – From coniferous trees (e.g., pine, spruce) – lightweight and easy to work with
— Hardwood – From deciduous trees (e.g., oak, beech) – denser and more durable
— Intermediate woods – Includes species like poplar or alder, which are neither extremely hard nor soft

2. Engineered wood and panels · Manufactured by bonding wood particles, fibers, or veneers for stability and versatility:
— Plywood – Thin wood veneers glued in alternating grain directions
— OSB (Oriented Strand Board) – Compressed wood strands for structural applications
— Chipboard (particleboard) – Compressed wood chips and resin, common in furniture
— MDF (Medium Density Fiberboard) – Fine wood fibers bonded into a dense, smooth panel

3. Naturally harvestable wood · Wood that can be collected without felling trees:
— Bamboo – A fast-growing, sustainable alternative
— Branches and rods – Small-diameter wood for rustic or decorative use

4. Structural and dimensional wood · Processed wood for construction and manufacturing:
— Trunk material – Whole tree sections, including large branches
— Sawn timber (lumber) – Cut and milled wood in standard forms:
— Boards – Flat, wide cuts for flooring, paneling, and furniture
— Beams – Thick, structural pieces for load-bearing applications
— Slats and strips – Narrow pieces for cladding or detailing

5. Composite and multi-layer panels · Engineered panels designed for specific functions:
— Three-layer board – Solid wood layers glued together, used in furniture
— Solid wood panel – Large panels made by gluing solid wood boards
— Laminated wood – Layers of wood glued together for added strength

# PROS & CONS

## Pros

Every material has its advantages, making it valuable for different applications.
Below is a breakdown of the key pros for the material category.

- Natural material
- Safe to work with - no toxic gasses emitted
- It is a beautiful material - pleasant to touch and amazing aroma
- Renewable material
- The material - and therefore also the waste - is biodegradable
- Round and thin branches are proportionally much stronger than sawn wood
- Offer great artistic freedom with versatile applications, from functional items to intricate sculptures
- Easy to work with - only require basic and affordable tools
- Excellent strength-to-weight ratio
- Can be $CO_2$-negative
- Wide range of shape opportunities with the material

## Cons

At the same time, each material comes with challenges which should be considered.
Below is a breakdown of the main cons for the material category.

- The slow growth rate
- Easily creates waste
- Lack of resistance to water, UV, bioagents (fungus + bugs)
- One-way oriented fibers should be considered
- Lack of resistance to fire

# HUMAN RELATIONS

( Human relations to the material )

A material is more than just its physical properties; when engaged with by humans, it can evoke emotions, memories, and associations—an important d imension that fosters greater respect and empathy for the material.
We asked the designers what emotions and associations the material evokes in them—whether through working with it or simply thinking about it.

## Associations

Working with wood can remind me of the first self-built tree house made of various old boards

Thinking about that it comes from a living being - probably why it is pleasant to our senses

The grain design is like an illustrated story and has a warm and soft touch

## Emotions

When working with a plane or other manual blade, it offers a gratifying resistance that causes comforting sounds

Feels great how the ambiance is being filled with an aroma which can feel like it transports us to the woods

# ROLE IN A CIRCULAR AGENDA

( The material's role in a circular agenda )

Each material has unique properties that determine its suitability for different contexts. Understanding these characteristics is crucial for applying materials effectively to support a circular agenda. Wood can contribute due to the following:

- → Wood is a material of the past and the future, wood has been used for centuries and continues to be relevant for modern applications
- → Wood can be a sustainable alternative to plastic and metal, offering a renewable and biodegradable option (depending on the context of course)
- → Renewable resource when sourced from responsibly managed forests (e.g., FSC-certified wood)
- → Is able to store carbon during its lifespan, helping to reduce $CO_2$ in the atmosphere
- → Easily repairable, reusable, and biodegradable making it a material that can contribute to circular systems
- → Can be repurposed and/or upcycled into new products, such as furniture, construction materials, or engineered wood composites
- → Wood is a naturally durable and strong material, offering longevity in many applications without necessarily requiring extensive processing
- → Can contribute to support local economies when sourced and processed locally/regionally, reducing emission related to transportation
- → Non-toxic and safe for many applications (unlike some synthetic materials that can release harmful chemicals)

# THIS MATERIAL IS AMAZING BECAUSE

"Wood has endless possibilities in its applications and is a pleasant, warm material. You can build almost anything with it, it grows back and is biodegradable."

Johannes Hoffmann

"Imagine a strong, flexible and lightweight material. Add the fact that it is super ecologically sustainable - it absorbs CO2. You can harvest it so that it grows back by coppicing. It all starts with a small seed and while you wait for it to grow, instead of buying, you can collect it yourself from landfills or the roadside."

Mariana Costa e Silva

"With our project [Found Objects] I see how every design decision contributes to generating economic, social, and ecological changes on a planetary scale. The production of interior design and ephemeral architecture demands certain materials (like wood) which are part of the planet's finite resources. I believe that what we treat as waste today could be seen as a resource, and systematically become a new raw material tomorrow. With our project, we are taking the first steps to give a use to this material, before it even becomes waste."

Paola Zanchetta Muñoz

# WE NEED TO RESPECT THIS MATERIAL BECAUSE

"This material is a living being and deserves our respect. Some boards are likely to be from trees that are older than yourself."

Mariana Costa e Silva

"The material is always available as a renewable raw material as long as we take care of the forest. This should of course be taken much more seriously worldwide, as the forest is the lungs of the earth and must be preserved at all costs."

Johannes Hoffmann

"I believe that furniture should be built more sustainably again so that its quality and design ensure that it remains beautiful and functional even after years."

Johannes Hoffmann

"We live in an anthropogenic reality where resource consumption exceeds nature's regeneration by 1.75 times. Wood demands responsibility. Before using it, ask: How long should my product last? Is wood ideal? Can I use local scraps instead of new material?"

Paola Zanchetta Muñoz

# TOOLS

( Tools & procedures )

By highlighting a list of relevant tools as well as care and maintenance procedures that can be applied when working with the material, you gain an overview of how to start working with the material and how to take care of it - preferably on an ongoing basis - aiming to extend the lives of the products and materials.

Tools · Machines · Procedures

## ( Hand tools )

Cutting tools like handsaw and coping saw

Hammer

Shaping a smootihng tools like chisels, mallets, wood rasps/files and sandpaper (various grits)

Measuring and marking tools like tape measure, pencil, ruler, combination square etc.

Fastening and assembly tools like a claw hammer, wooden/rubber mallet, screwdrivers, hand drill, hand clamps

Miter box - can also be 3D-printed

Jointing and precision tools like a try square, bevel gauge, doweling jigs etc.

## ( Power tools and workshop machines )

Table saw - essential for precise rip cuts and crosscuts

Miter saw - for creating accurate angled cuts

Band saw - for curved cuts

Planer - helps leveling and smoothening rough wood surfaces

Jointer - can flatten and square wood edges for better joinery

Drill and driver

Jigsaw, circular saw, router (to shape edges and joinery)

CNC cutter

Laser cutter - mainly thinner wooden panels. This technique provides with fast and easy programming

# TOOLS

Care · Maintenance

For wood, different types of surface treatments with natural materials and techniques exist:

Clean regularly - wipe wooden surfaces with a dry or slightly damp cloth to remove dust and dirt

For more thorough cleaning, apply a mild soap or a wood-specific cleaner - avoid harsh chemicals

Protect wood from moisture. Keeping it away from prolonged exposure to water will help prevent swelling, warping or mold growth

Avoid too much direct sunlight and heat since excessive exposure to sunlight can cause fading and heat sources (e.g. radiators, fireplaces) can contribute to drying out and cracking the wood

To maintain and care for the surface, apply oil or wax - e.g. boiled linseed oil, beeswax or other hardwax oils

If the wood has a protective finish, reapply this when the surface starts to wear down

Seal wood products that will live their lives outdoor to protect against moisture and exposure to UV

Check and tighten screws, bolts, and joints in wooden products and structures to prevent them from becoming instable

Repair scratches and dents – use e.g. wood filler, wax sticks, or sanding to fix smaller damage. Apply a matching finish to restore the appearance

Inspect the wood regularly for termites and/or wood-boring insects - this especially counts for untreated or wood that is standing outdoor

The traditional Japanese preservation technique, *Yakisugi* (burnt timber cladding), can also be applied. This method involves charring the wood surface aiming to enhance the durability, water resistance, as well as pest resistance. The burnt layer will protect the wood, which also makes it ideal for outdoor applications.

PROJECT INSIGHT

Working with solid wood is ideal, as each type has unique properties and characteristics. For example, oak and larch are well-suited for outdoor use due to their durability. Panel materials, on the other hand, are excellent for furniture making but are generally more suitable for indoor applications. Even within panel materials, there is a wide range of options designed for different purposes.

# CON-STRAINTS

( Creative constraints & attention points )

A creative constraint is any circumstance or condition that limits creative options in some way. Setting limitations is essential, as it can both foster greater creativity and encourage consideration of nature and the environment early in product development.

The designers have shared their suggestions for creative constraints that could be integrated into practice when working with this material category.

## Suggested constraints

- Avoid using new materials - source from waste
- Avoid organic shapes as they tend to create more waste
- Allow large tolerances in designs
- Use the lowest quantity of wood possible to generate the stability of the piece
- Make the most of the orientation of the fibers
- Source wood that is no longer in use, such as canes, rods, and branches—i.e., non-commercial wood sources
- Design for disassembly making sure parts and components can be separated
- Do not apply glue
- Select local/regional sources of wood

# CON-
# STRAINTS

To work sustainably and responsibly with the material, it is essential to consider key attention points in its use.

## Attention points

Think about how you can deal with irregularity and curvilinear shapes in the design phase

Ensure you select wood based on its specific properties, such as color, weight, and durability, while also considering the most suitable tree species for its intended application, such as indoor or outdoor use

Remember that certifications of suppliers in the wood industry cannot always be fully trusted

Coppicing comes from the stone age and is the most sustainable way to exploit the resource

It is important to rethink the format in which we consume the resource:
- Is it necessary to use panels or saw mill wood?
- and is it really necessary to make designs from perfectly flat and orthogonal materials?

Working with solid wood requires the use of machines and hand tools. When cutting, planing, sawing, milling and sanding, chips and dust are being generated. The procedures are often dusty work. Pay attention to occupational safety, use dust masks, hearing protection, etc.

# ADVICE

Discover expert advice from designers on working with each material — whether you are looking to deepen your understanding or start prototyping.

## The makers' best advice

Embrace experimentation—whether through structured testing or trial and error. Start with something simple, learn from failures, and try again with new insights

Explore how you can reuse pallets, packaging, degraded furniture and scraps

## Start getting to know the material

Find someone nearby, e.g. a carpentry shop, or someone who can build things and seek support from experienced craftsmen. This can both be in the beginning of a process but also later if you feel stuck or get tired

Find the open workshop(s) and/or makerspace(s) nearby you

## When prototyping with the material, think about the following

Make a prototype of your design out of cardboard first before making one out of wood. The chances that you'll discover potential changes and/or adjustments/flaws in your design by doing this is high

Make a sketch and write down measurements

Use templates. You can use 3D printing to fabricate useful tools like connectors, miter boxes, drilling guides and tenon makers

Plan thoroughly before starting your project. When purchasing materials, choose carefully to avoid errors and ensure you buy the right amount—keep in mind that solid wood can have up to 50 pct. waste

Recommendation 01

# FOUND OBJECTS

Found Objects is an open-source design tool that optimizes digital fabrication by reducing wood waste. CNC routers and other digital tools enable custom production with minimal shape restrictions, but this flexibility often leads to inefficient material use. Found Objects addresses this issue by using software that detects leftover sheet material before production begins, generating functional components that seamlessly fit into available spaces.

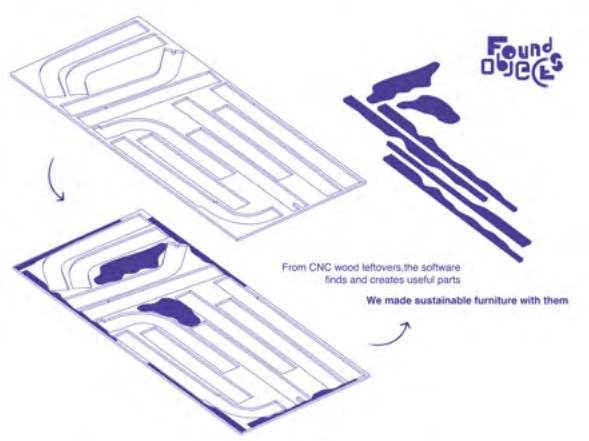
Initially applied to interior elements, the project aims to expand by inviting production facilities, artists, and designers to explore new creative possibilities. The process allows control over generated forms, ranging from organic and curvy to angular and geometric, ensuring both aesthetic and practical applications.
By transforming waste into new building materials, Found Objects demonstrates the potential for sustainability in the furniture and interior design industries. It offers a scalable solution, applicable from small-scale makerspaces and FabLabs to large commercial production settings.

Found Objects highlights how technology and design can work together to create more sustainable production methods, reducing negative environmental impact while fostering creativity and innovation.

Learn more →

Distributed Design Platform

Found Objects




Recommendation 02

# FAZ COM AS TUAS MÃOS

“The revolution in object manufacturing is happening: product design is at the service of the user-maker - DO it with your hands!”. FAZ is a participatory manufacturing process: easy-to-build furniture and toys, with local, biodegradable or reused materials, basic tools and workshops for beginners designed to convey the pleasure of building something with our own hands without complications, just fun!

We live surrounded by objects, our relationship with them is that of mere consumers and users, we do not intervene in their creation. Manufacturing is something distant, “very technical”, complex and inaccessible in most cases. However, we take great pleasure in doing things with our hands: mindfulness, crafts - crochet, knitting, sewing. What if we included carpentry?! If building furniture was as affordable as making a scarf? Cheap, easy to find materials and a couple of hand tools. It was with this objective that “FAZ com tuas mãos” was created: quick training, without the need for special facilities, for beginners to build furniture.

Design is key to integrating functionality and ergonomics into a construction method that uses common materials such as wood or pallets, with basic tools such as a hammer and saw, without resorting to special techniques, to build benches, chairs, tables or whatever the occasion demands. The surprise and satisfaction of doing something, apparently so distant, with our own hands, in such an immediate way, recorded in an everyday object, is the greatest gratification provided to participants in these workshops.

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# EPILOGUE

## A circular future begins with a deeper respect and empathy for materials.

( Epilogue )

Materials matter. Their properties, potentials, and impact are deeply intertwined with how we design, create, and live. Through the exploration of eight material categories, we have uncovered the materials' strengths and weaknesses, their roles in a circular economy, and the insights of makers and designers who have dedicated themselves to understanding and experimenting with them. We have also provided with suggestions for tools to apply, best practices, and care procedures. Making responsible material choices is not just about selection; it extends to how materials are used, maintained, and can help achieving longevity. This call for a more holistic approach to materials where the entire lifecycle of materials and products is considered—from before they are sourced, through extraction, production, use, and ultimately, their end-of-life.

We hope this resource has not only expanded your knowledge but also helped you gain new perspectives. Materials are much more than just passive elements in products and spaces. They are valuable and unique resources that deserve to be treated with respect and empathy. Perhaps this resource has helped sparking new ideas about how to integrate better material choices into your personal life or professional practice. Where do you see potential for change? And how can you help increase awareness and respect for materials in your own field?

Each material is unique. By understanding their unique qualities, we can make more informed decisions that better support a circular and sustainable agenda. Choosing the right material, using it wisely, and extending its life through care and attention are all crucial steps in shifting our relationship with materials towards a more empathetic and emotional one which ultimately can help leading to increased durability. We believe that fostering this respect and awareness is a powerful contribution to a more sustainable future.

Material Insights is not a definitive guide to all materials, nor does it claim to be. The science of materials is vast, complex, and ever-evolving—far too intricate to be summarized simply. Instead, this publication has aimed to serve as an introduction, offering deeper understanding, fresh perspectives, and, hopefully, sparking new reflections on how we can cultivate greater empathy and respect for materials and the scarce resources on the planet.

# THANK YOU!

Credit

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Call to Action

Do you work with products and materials on a daily basis and wish to connect with us?
Or do you have inputs or enquiries regarding this publication?
Then we would be happy to receive your contact and inputs.
Send an email the author of the publication – Therese Balslev, on thb@ddc.dk


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