DO IT YOURSELF

HEMP

HEALING ARCHITECTURE

WOOD

WAR DAMAGES

MATERIAL BOOK

CLAY

NATURAL FIBERS

PARTICIPATION

FUNGI

REED

RESIDUAL MATERIALS

RE:USE

SHEEP WOOL

STRAW

TRAUMA THERAPY

CIRCULAR CONSTRUCTION

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НАДІЯ

ZWISCHEN
МІЖ
BETWEEN

HOPE

HOME

ZWISCHEN
МІЖ
BETWEEN

НА - ІНШОМУ - НА - НОВОМУ - НАЗАД - НАВКОЛО - РАЗОМ - МІЖ - **БУДУВАТИ**

ДІЯТИ - ПРОНИКНІСТЬ - СКАРБ - ПОЗИЧАТИ - ЖІНОЧІ ЗНАННЯ - ПРОБУВАТИ - БАЧИТИ СТАРЕ НАНОВО - ПРОСИТИ - РОЗКОПУВАТИ - ТКАТИ - ТЕПЛИЙ - ФАКТУРИ - ОСЯГНУТИ - НЕТЕРПЛЯЧИЙ - СПІВПРАЦЮВАТИ - КОМПОСТ - ФУНДАМЕНТАЛЬНИЙ - DAVIDAE >< ГОЛІАФ - ОВЕЧА ВОВНА - ЛАНОЛІН - АКУСТИЧНИЙ ПАНЕЛІ - ГЛИНА - КОРИСНІ КОНОПЛІ - КОНОПЛЯНІ ВОЛОКНА - СТЕБЛА КУКУРУДЗИ - ТИРСА - ОЧЕРЕТ - СОЛОМА - КОРА - ГРИБНИЙ МІЦЕЛІЙ - ГРИБНЕ БУДІВЕЛЬНЕ КАМІННЯ - СТЕБЛА ЗЛАКІВ - РОСЛИННІ РЕШТКИ - ОРГАНІЧНІ ВІДХОДИ - БІОЦЕГЛА - ПРИКЛАДИ ДЛЯ НАСЛІДУВАННЯ! - МІЖПРОСТІР - МАТЕРІАЛЬНИЙ ЦИКЛ – СІЛЬСЬКЕ- ЗБИРАННЯ ГОСПОДАРСТВО - ЗАЗЕМЛЕННЯ - ЗЕМЛЯ - ПОДВІР'Я - ДІМ - НАДІЯ - КРУГОВИЙ - ДОМОРОЩЕНИЙ - ЗРОСТАЮЧИЙ ДІМ - ФУНДАМЕНТ - МІЖДИСЦИПЛІНАРНИЙ - ЦІЛЮЩА АРХІТЕКТУРА - ВИКОРИСТАННЯ - РОЗШИРЕННЯ МОЖЛИВОСТЕЙ - РОЗВИВАЄМОСЬ РАЗОМ - РОЗПЕЧАТУВАННЯ - НАДАННЯ ПРОСТОРУ ТРАВМІ - УКРИТТЯ -

BUILDING - DIFFERENTLY - PARTLY - NEW - BACK - AROUND - TOGETHER - BETWEEN -

ACT - CREATE PERMEABILITIES - LIFT TREASURES - WOMEN'S KNOWLEDGE - ORROW - TRY OUT - SEE OLD THINGS ANEW - ASK - EXCAVATE - WEAVE - WARMING - TEXTURES - EXPLORING - COOPERATING - COMPOSTING - BASIC IMPATIENT- DAVIDAE >< GOLIATH - SHEEP WOOL - LANOLIN - ACOUSTIC PANELS - CLAY - HEMP - HEMP FIBERS - CORNSTALKS - SAWDUST - REED - STRAW - BARK - MUSHROOM MYCELIUM - MYCELIUM BRICKS - CEREAL STALKS - PLANT RESIDUES - ORGANIC WASTE - BIO-BRICKS -EARTH - YARD - HOME - HOPE - EXAMPLES TO FOLLOW! - INTERSPACES - MATERIAL CYCLE - AGRICULTURE - GROUNDING - CIRCULAR - GROWN HOME - GROWING HOME - FOUNDATION -HEALING ARCHITECTURE - INTERDISCIPLINARY - USE – SELF EMPOWER-MENT - DEVELOPING TOGETHER - UNSEALING - GIVING SPACE TO TRAUMA - SHELTERING - GATHERING - HOSTING

AN– ANDERS– AUF– NEU– RÜCK– UM– VER- ZUSAMMEN - ZWISCHEN - **BAUEN** •

HANDELN • DURCHLÄSSIGKEIT • SCHÄTZE HEBEN • ANLEIHE NEHMEN • FRAUEN-WISSEN • ERPROBEN • ALTES NEU SEHEN • FRAGEN • AUSGRABEN • VERWEBEN • WÄRMEN • TEXT-UREN • ERGRÜNDEN • UNGEDULDIG • KOOPERIEREN • KOMPOSTIEREN • GRUNDLEGEND • DAVIDAE >< GOLIATH • SCHAF-WOLLE • LANOLIN • AKKUSTIK-PANELE • LEHM • NUTZHANF • HANFFASERN • MAIS-STÄNGEL • SÄGEMEHL • REET • STROH • RINDE • PILZMYZEL • PILZBAU- STEINE • GETREIDEHALME • PFLANZENRESTE • ORGANISCHE ABFÄLLE • BIO-BRICKS • EXAMPLES TO FOLLOW! • ZWISCHEN-RÄUME • STOFFKREISLAUF • AGRIKULTUR • GROUNDING • ERDUNG • HOF • HOME • HOPE • ZIRKULÄR • GROWN HOME • GROWING HOME • FUNDAMENT • INTERDISZIPLINÄR • HEALING ARCHITECTURE • GEBRAUCHEN • SELBSTERMÄCHTIGUNG • GEMEINSAM ENTWICKELN • ENTSIEGELN • TRAUMA RAUM GEBEN • BEHERBERGEN • VERSAMMELN

Content

Introduction

For centuries, Ukrainian houses have traditionally been built from simple, locally sourced natural materials: wood, clay, straw, and reed form the basis of this construction method, which can be found in different types across the country. These materials are widespread, renewable, and used in various combinations depending on regional conditions. Despite their simplicity, the buildings are durable, stable, well-insulated, and sustainable. They reflect a deep understanding of the natural environment and embody a vibrant building culture that has existed in harmony with nature for centuries.

The HOPE HOME • НАДІЯ Material Book highlights the potential and significance of natural materials, as well as their reinterpretation in contemporary construction. The individual articles provide practical knowledge, fundamental information, and research findings on building with straw, reed, clay, and wood. We have also expanded the range to include other climate-friendly materials such as hemp, mycelium, and sheep's wool.

Working with natural materials, conducting collaborative research, organizing workshops, and building together open new spaces, create a sense of belonging, layer new experiences over heavy old memories, and enable healing.

By scientifically supporting the reuse, repurposing, and reprocessing of rubble materials as a resource emerging from war, we envision an architecture that can also have a socially regenerative effect.

To deepen this exploration, we have structured the Material Book into three practice-oriented chapters that address concrete war damage, facts and figures, and social knowledge, setting everything into relation: artists and architects share their experiences with participatory architecture using reclaimed, found, and leftover materials; researchers and therapists address war trauma and healing architecture as a major challenge for Ukraine's rebuilding.

Designed as an open-source reader, this publication aims to make its knowledge freely accessible in three languages to anyone curious, learning, or researching. It is action-oriented and builds on insights from twelve online workshops where Ukrainian and German experts shared their knowledge and experience with these building materials.

As a collaborative project, it has been bringing together since 2024 professionals from universities, crafts, practitioners, and communities from both countries, connecting different disciplines, strengthening the foundation for further research into natural, regenerative materials for Ukraine's reconstruction, and increasing their public visibility.

This handbook emerged from the urgent and undeniable need to repair, rebuild, and rethink homes, schools, public spaces, and infrastructure — a need triggered by the Russian war of aggression.

HOPE HOME • НАДІЯ is a pilot project for radically different, ecological construction. It is conceived as a contribution to a "green" recovery of the war-torn country and demonstrates how sustainable, locally available materials can make reconstruction both ecologically and economically relevant.

By doing so, Ukraine can reduce its dependence on the globally operating conventional concrete industry, strengthen regional economic cycles, develop innovative methods for rubble reuse, and become a pioneer of ecological, regenerative building practices. It is not only about restoring what was destroyed, abandoned, and lost, it is about designing a new, resilient, and sustainable future. Natural materials, deeply rooted in Ukrainian building culture, are the key building blocks of this transformation.

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HOPE HOME • НАДІЯ – An Example to Follow for Green Recovery in Ukraine

A Conversation between Adrienne Goehler and Anastasiia Zhuravel

AZ: Among the many urgent questions shaping the future of Ukraine, the reconstruction of destroyed or damaged homes, landscapes, urban and rural areas occupy a central place. But what does it mean to rebuild sustainably, not just in materials but in values, in community, and in method?

HOPE HOME • НАДІЯ is one of the few pilot projects that offers an alternative to conventional, industrial approaches to reconstruction. It emerges from the civil society sector, but its ambitions reach further, toward long-term ecological, social, and emotional recovery. Its goal is not only to provide housing, but to model a green, community-engaged, and scalable vision for rebuilding Ukraine after war.

At the center of this project is Adrienne Goehler, a Berlin-based psychologist, author and curator, whose transdisciplinary and collaborative practice brings together architecture, ecology, art and community-building. In this conversation, we speak about the meaning behind HOPE HOME • НАДІЯ, its green materials and principles, and the deeper cultural and ethical questions behind reconstruction.

AZ: HOPE HOME • НАДІЯ is a pilot project that does not follow the usual path of post-war reconstruction. Can you tell us what the project is about, why it was launched, and why it was important to implement it in Ukraine in particular? What kind of »hope« does the project aim to offer, and for whom?

AG: It all started with the last venue of the travelling exhibition EXAMPLES TO FOLLOW! with which I travelled around the world for 13 years. This last exhibition focused on current artistic and scientific approaches to traditional building materials such as hemp, wool, willow, straw, and their interconnections. Added to this were the relatively new scientific research findings on fungi as an organic building material.

We had built houses out of wool and hemp, created connections between all these materials in workshops, and in the end, the question arose as to where this collected knowledge, which corresponded to the latest research, could find its most meaningful practical application.

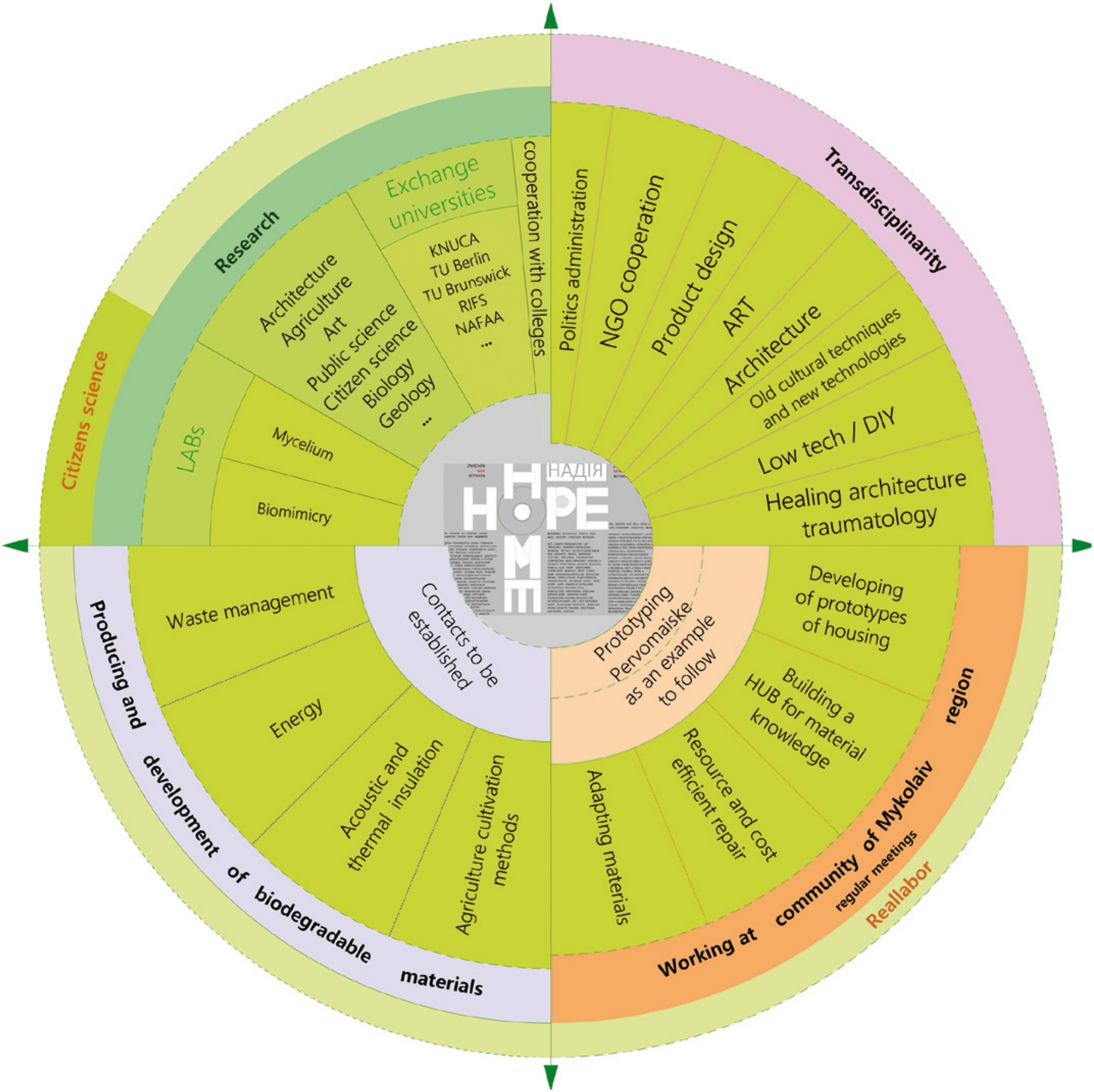
»Somewhere where it really, really matters« was the main idea.

All those involved voted either for a war zone or for an area affected by a natural disaster. In other words, areas where, in addition to human suffering, injury, and displacement, nature has also been severely damaged and collapsed houses, whether due to shelling or flooding, have additional extreme ecological consequences.

All the building materials we worked with and exhibited are characterized by the fact that they are CO_2 neutral or even CO negative in their processing, renewable, and compostable, in contrast to conventional building materials such as concrete and steel, whose climate and environmental impact is devastating. The conventional, globally active concrete construction industry is responsible for

- 30 % of CO_2 emissions
- 40 % of energy consumption
- 50 % of resource consumption
- 60 % of waste generation
- 70 % of soil sealing (Source: Baukultur+)

In contrast, 1 m^3 of hemp-lime stores 75 kg of CO_2.



HOPE HOME • HOPE Circle ©Sofia Galat, Adrienne Goehler

AZ: At this stage of the war, we are beginning to understand that civil society initiatives, especially those that incorporate ecological thinking, can play a transformative role in rebuilding Ukraine. Is there a long-term ecological or regenerative goal embedded in HOPE HOME • НАДІЯ?

AG: Our aim is nothing less than to demonstrate a holistic perspective for comprehensive ecological reconstruction in a pilot village in the Mykolaiv region, and to orchestrate the already well-established Ukrainian-German transdisciplinary network for this purpose.

AZ: Let's talk more specifically about materials and construction methods. What environmentally friendly or locally sourced materials are used at HOPE HOME • НАДІЯ? How did you arrive at this selection, and to what extent does it correspond to both the Ukrainian context and the broader global debate on sustainable approaches?

AG: We are dealing with the entire spectrum of sustainable building methods: from the necessary soil decontamination to the cultivation of organic building materials, the reuse of materials from destroyed houses, and model house construction using hemp, straw, clay, and reed, as well as issues of certification and scalability of materials.

AZ: The project is described as a transdisciplinary and collective effort. Can you tell us more about the internal methodology of the project? How are architecture, art, social design, and social engagement linked in practice?

AG: The project also connects natural sciences and agriculture with local entrepreneurs, and from both countries, universities and colleges, as well as companies and NGOs; all in close cooperation with the village council of Pervomaiske, Ukraine. We decided to repair and rebuild in rural structures because they are in the slipstream of the concrete construction industry cartel and because we can find the materials and knowledge there to build on old cultural techniques.

This is also why we chose the southern region of Mykolaiv, the breadbasket of Ukraine, where straw is the most important by-product. In addition, village structures are the most likely place for us to build on »Toloka«, the cultural tradition of neighbor's helping each other with harvesting, house building, and house repairs. And with the Mykolaiv region, we have also signed a memorandum with the head of the military administration for our extensive project.

AZ: Projects like HOPE HOME • НАДІЯ require not only financial resources and technical knowledge, but also emotional resilience and a long-term vision. As a German curator working in Ukraine, where do you personally find the energy to keep going? And what advice would you give to others—in Ukraine or abroad—who are launching similar initiatives for green recovery?

AG: The financial resources for all the steps we have taken so far have been too scarce and could only be managed with considerable self-exploitation; This can only be offset by the conviction that what we are doing in Ukraine makes all the difference to the internationally active concrete industry cartel. It is David versus Goliath, the diverse, traditional knowledge of women and men with new scientific conclusions against those who are champing at the bit for big returns. And secondly, out of a deep sense of practical solidarity with the victims of Russia's war in Ukraine, which violates international law. While Western leaders seem so incredibly powerless, we have begun to imagine and build a green future there with young and old Ukrainians, with craftspeople, local industries, students, professors, NGOs. HOPE HOME • НАДІЯ!

DavidAE >< Goliath
David (m. singular)
DavidA (f. singular)
DavidAE (f. plural)

Working title before HOPE HOME • НАДІЯ
© Adrienne Goehler

WORKSHOPS HOPE HOME • НАДІЯ

January/ February 2024
- 17.1.2024
  Getting to know each other and initiation - Zoom
  Core Team UA and Core Team G
- 26.2.2024
  Oblast Mykolaiv and first idea of workshops
  Core Team UA and Core Team G

March/ April 2024
- 18.3.2024
  Hemp
  Sergiy Kovalenkov, Oleksii Brustnitsyn, Norbert Höpfer, Werner Schönthaler
- 22.4.2024
  Fungi
  Julia Bialetska - S. Lab-Sustainable Laboratory, Yova Yager, Vera Meyer, Sven Pfeiffer, Martin Rahmel, Natalija Miodragovic

May 2024
- 7.5.2024
  Sheep wool
  Volodymyr Aleksandrovich, Kostraba Evgeny Dmytrovych, Folke Köbberling, Tobias Pörschke, Andreas Flock
  supported by Allianz Foundation
- 22.5.2024
  Earth, wood, natural fibers.
  Sergiy Sherstnyov, Eugene Kuzmenko, Sofia Galat, Eike Roswag-Klinge, Julian Mönig
  supported by Allianz Foundation

June 2024
- 10.6.2024
  Straw
  Oleksii Brustnitsyn, Serhiy Polishchuck, Adrian Nägel, Katrin Pütz
- 19.6.2024
  Transdisciplinary project funding
  Yuri Androsiuk, Kyiv School of Economics, Sofiia Pyshnieva, Christine Bismuth, Florian Schneider

supported by Heinrich Böll Foundation Kyiv

July 2024
- 1.7.2024
  Reuseable and participatory architecture from found and residual materials
  Olga Honchar, Anna Prokajewa, Folke Köbberling, Benjamin Förster-Baldenius
  supported by Allianz Foundation
- 17.7.2024
  Reed
  Igor Khleban, Yakusha Studio, Almut Grüntuch-Ernst, Elisabeth Andres
  supported by Allianz Foundation
- 31.7.2024
  War damages
  Ecoaction, Helen Ivanova, Joanthan Banz, Basil Roth
  supported by Allianz Foundation

August 2024
- 28.8.2024
  Social anchoring, participation, healing architecture
  Anastasia Zhuravel, NN, Inna Obelets, Lena E. Grabowski
  supported by Allianz Foundation

September 2024
- 10.9.2024
  Chambers of Architects
  Anna Kyrii | Vice President Chamber of Architects Ukraine, Theresa Keilhacker | President Chamber of Architects Berlin, Andreas Rieger | | President Chamber of Architects Brandenburg

October 2024
- 14.10.2024
  Climate friendly resource utilisation
  Yevheenia Aratovska, Nikolai Stepanets, Corinna Vosse, Alexa Kreisl
- 28.10.2024
  International research funding for university cooperation
  Helena Kovalska| Kyiv University of Construction and Architecture, Kyiv Academy of Fine Arts and Architecture, TU Braunschweig, TU Berlin

Fungi laboratory for the production of fungi-based materials + straw/hemp in combination with remains of buildings

HOPE HOME • НАДІЯ Phase 1, Zoom Workshops

Fig. right: materials from top left to bottom right: Mushrooms © Maryna Shchehelska, Reeds © Natalia Azarkina, Beverage cartons © Alexa Kreissl, Clay bricks © Natalia Azarkina, Sheep's wool © Natalia Azarkina, Straw © Natalia Azarkina, Hemp © Natalia Azarkina, Sheep's wool © Natalia Azarkina, Hemp ball © Natalia Azarkina

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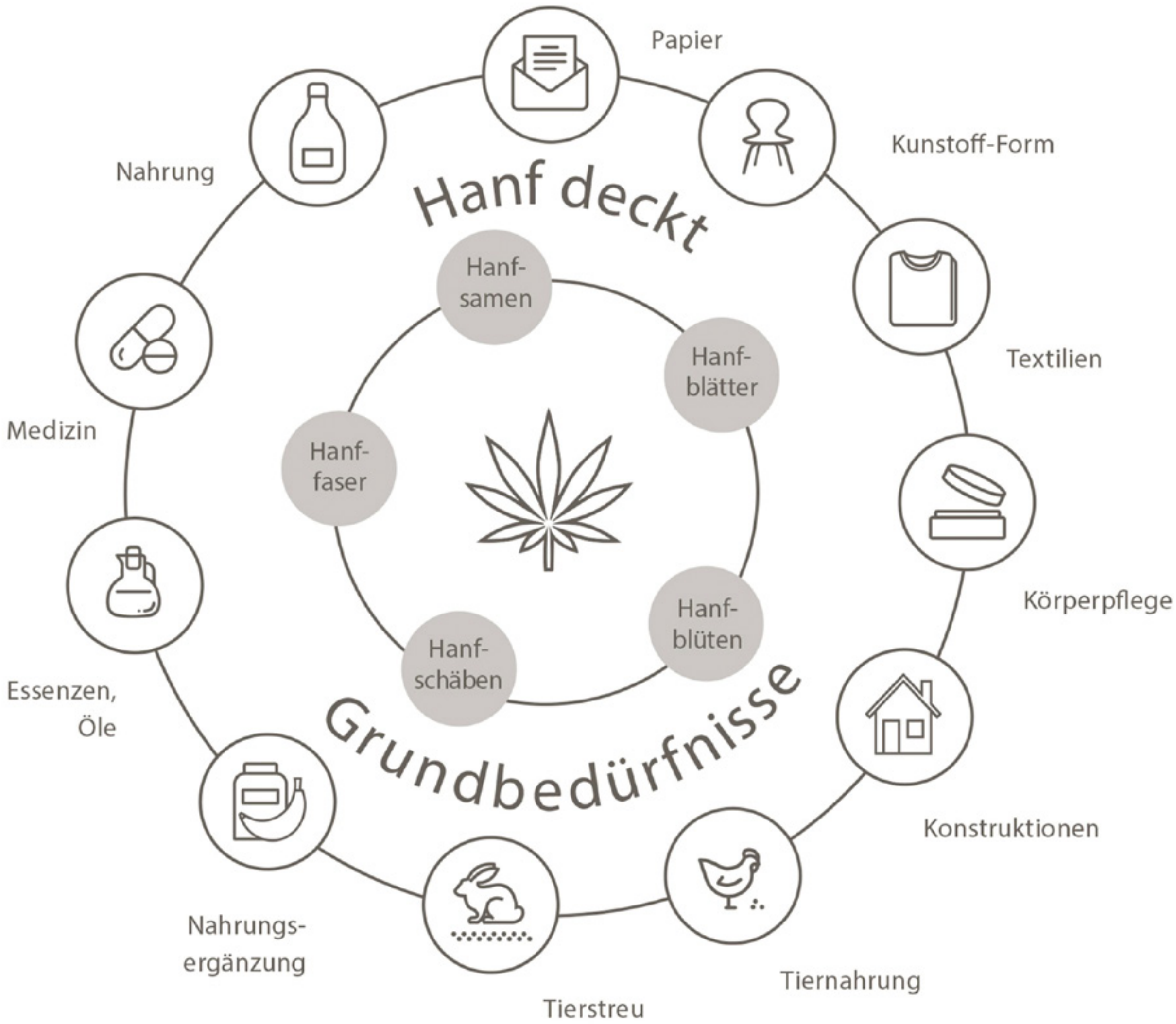
Fig. 1: Overview of hemp © www.hanfstein.eu



Hemp meets basic needs
(clockwise): paper, plastic molding, textiles, personal care, construction, animal feed, animal bedding, dietary supplements, essences/oils, medicine, food.

(inner circle, clockwise): hemp seeds, hemp leaves, hemp flowers, hemp shives, hemp fiber.

Hemp

»Renewable, ecological, CO_2-negative* and compostable« — this brief formula captures the essence of industrial hemp.

When properly processed, hemp-based building materials are long-lasting (suitable for future generations). Combined with lime as a binder, hempcrete regulates humidity, resists moisture, and ensures the continuous drying of walls. When produced within a regional value chain, it is also an inexpensive building material.

In ancient China, as well as in medieval Europe, hemp was used for making ropes, tents, clothing, and insulation. In the former German Democratic Republic, up until its dissolution in 1990, there was industrial textile production based on nettle, flax, linen, and hemp. There was even specialized training in machine engineering for processing plant fibers in the textile sector.

Although hemp disappeared from textile manufacturing for a time, since around 2020 hempcrete has re-emerged in Germany as a building material.

FOOTNOTE: * CO_2-negative means: approx. 75 % of all man-made global warming is attributable to the greenhouse gas CO_2. 1 ton of hemp binds 1.5–1.8 tons of CO_2 during growth; hemp concrete stores CO_2 permanently.

Hempcrete Compared to Conventional Building Materials

Comparison	**Conventional building materials such as aerated concrete, highly insulating brick walls, or heavy building blocks like sand-lime brick in combination with an external thermal insulation composite system (ETICS)**	**Agricultural concrete hempcrete** (Concrete is defined as a building material consisting of coarse aggregate and binder. In hempcrete, these are hemp shives and lime)
Raw materials	Complex agglomerate of clay, sand, gravel, cement, lime, aluminum, perlite, plastics, mineral wool, polystyrene, flame retardant, water. Not renewable	Simple recipe of hemp shives, lime, and water. Sand-free construction, pesticide- and glyphosate-free. Regenerates in 100–120 days
Production	Central	Fundamentally regionally possible
Energy balance	High	Medium to low
CO_2 balance	In jedem Fall positiv = der Baustoff produziert in der Herstellung CO_2	Negative = in the building material more CO_2 is stored through the plant mass than is generated during production, approx. minus 100 kg CO_2 per cubic meter
Universally applicable	No, only for defined wall and floor elements	Versatile in use as wall material (hemp blocks or formwork concrete) or insulating screed, easy to shape
Fire protection	ETICS systems are vulnerable, e.g. due to styrofoam (EPS), which melts, drips and promotes spreading; mineral wool is also a source of danger	B - s1 d0 (hardly inflammable, no smoke development, no burning droplets)
Monolithic construction	Only with pure insulating blocks (aerated concrete and insulating bricks)	Rigid, capillary-active structure without air layer
Moisture protection	Varies: poor to low	Active moisture protection and re-drying, highly vapor-permeablen
Disposal	Composite building material = hazardous waste, very high recycling effort	Defined mixture of lime and hemp. Recyclable, reusable as a building material
Substrate as plaster base	As a rule, only special plasters with cement and plastic can be applied	Universally suitable for lime and clay plaster, suitable for construction site mixtures
Advantages/ Disadvantages	Mass production, load-bearing, hazardous waste in disposal, low moisture protection	Universally and regionally producible. Built-in moisture protection. Rammed concrete with high insulation thicknesses requires longer drying times, not load-bearing, large construction site mixers needed
Use as insulating wool	Synthetic insulating wool, boards, glass/rock wool, styrofoam. Toxic in case of fire. Irritating to skin/lungs, partly carcinogenic. Aging, shrinkage, moisture-prone	Stuffing wool made from natural hemp fibers. Built-in restoring force (shrink-free) and moisture-regulating. Non-toxic

Urgent
For climate protection, sustainable construction, and the circular economy, industrial hemp is becoming indispensable for house building. Together with solar energy, passive houses, and cradle-to-cradle concepts, local, low-carbon, and regenerative materials are transforming building culture. These materials are not only environmentally friendly but also economically affordable and rooted in regional knowledge and traditions. Among them, hemp has emerged as one of the most important building materials, especially in Ukraine, where industrial hemp has long been cultivated and used in house construction.

By the end of the 2010s, Ukraine was one of the few countries in Eastern Europe where hempcrete—the natural composite made from hemp shives, a lime binder, and water—was being produced. Unlike in Germany, in Ukraine hemp is certified as a building material, playing an increasingly important role in non-load-bearing insulation and interior construction, while also opening the way toward other bio-based materials such as straw and reed.

In discussions about material use, post-war reconstruction, and climate-resilient architecture, hemp is gaining increasing importance.

Norbert Höpfer – Mobile Hempcrete and Low-Tech Construction

Dr. Norbert Höpfer has been working with hempcrete since 2002, making him one of the pioneers of bio-based construction in Central Europe. With a background in mineralogy, he developed mobile, low-tech building methods using hemp to promote barrier-free and sustainable construction. His approach focuses on minimalist yet highly efficient formulations, and his production is oriented toward rural areas, where he collaborates with residents to create fast and environmentally friendly housing solutions.

Since 2006, he has been formulating hemp-lime mixtures and managing construction sites. Today, his work concentrates on hempcrete as a CO_2-negative, sand- and cement-free, vegan material based on a transparent supply chain.

In the exhibition EXAMPLES TO FOLLOW!, he demonstrated the simplicity of his method: with two helpers, simple partly self-made tools, a mixer, a workbench, and a few containers, he built a complete timber-framed tiny house in less than a week. His work inspired many exhibition visitors to see how bio-based construction can provide quick and scalable solutions for emergency shelters, small homes, or mobile units.

4 parts hemp shives + 1 part lime + 1 part water
This formula avoids the use of sand and cement. Hempcrete is about three times lighter than water and half as heavy as wood, making it ideal for transport, handling, and manual assembly. The hemp shives store the carbon absorbed during plant growth, bound by lime, which continues to absorb CO_2 during curing. In this way, a carbon-negative, breathable insulation material is created. (Fig. 2)

Various construction methods are used with hempcrete:

- Hemp insulation blocks as masonry for exterior and interior walls allow for rapid construction progress.
- In-situ casting on site, where the mixed hempcrete is placed using sliding formwork. Drying times need to be considered, depending on insulation thickness. Since hemp-lime and hemp-clay absorb a lot of moisture, the initial drying process is relatively slow. When blocks are produced, they usually dry within one month; if a lining shell is tamped, significantly more time is required depending on thickness.
- Spraying hemp shives and lime with special machines allows for quickly filling timber-frame walls. This method has been successfully used in Ukraine, as well as in various projects in France and Germany.

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4 Parts of Hemp shives = 120 kg/ cubic meter + 1 Part of Lime = 250 kg/ cubic meter + 1 Part of Water = 250 kg/ cubic meter

Fig. 2: Recipe for hemp lime, information on volume and weight per cubic meter © Norbert Höpfer

Fig. 3: Hemp storage, mobile drying racks and finished hemp limestone in the exhibition RECOMMENDED FOR IMITATION!, Berlin 2023 © Norbert Höpfer

Fig. 4–6: Steps in the production of hemp building blocks © HOPE HOME • НАДІЯ

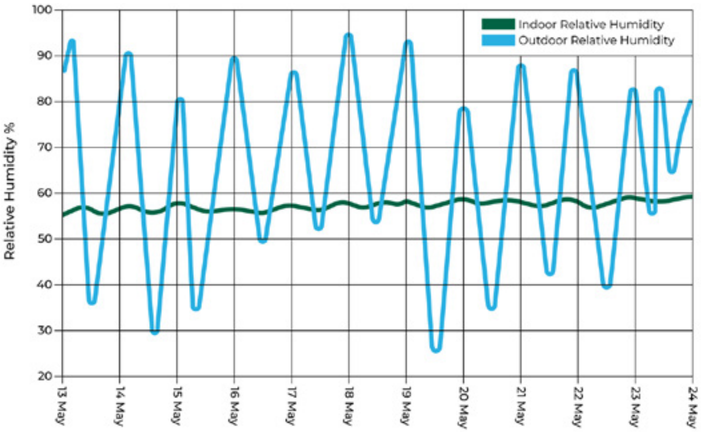

Fig. 7: Hemp stabilizes the temperature and regulates humidity in indoor spaces and balances out temperature fluctuations © Hempire

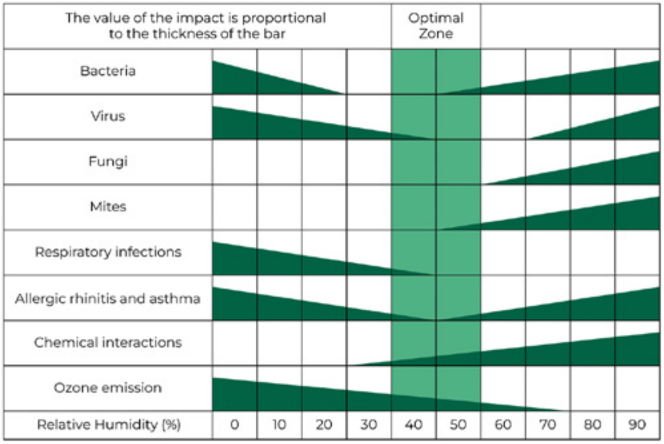

Fig. 8: At a relative humidity of approximately 50%, the growth of bacteria, viruses, fungi, and mites is reduced; the risk of respiratory infections and allergies decreases; conditions are healthiest and most comfortable for humans. © Stirling, Arundel, Sterling (1985): Criteria for Human Exposure to Humidity in Occupied Buildings

In Germany, the construction season for hempcrete generally lasts from April to October, when temperatures and air circulation are favorable for drying. A mobile hempcrete production unit, including mixers and drying racks, requires about 200 to 250 square meters of space. For building a small house, approximately 25–35 m³ of hempcrete is needed. The blocks are hand-tamped into wooden molds and dried on racks; surfaces are leveled with two 18 mm boards to achieve uniform height, with hand presses used instead of mechanical systems. A single wooden mold is sufficient to produce around 1,500 blocks.

In (post-war) regions such as Ukraine, destroyed house and room walls can be rebuilt with hemp-lime, provided that the building's structural stability is ensured. If necessary, pillars and timber posts must be checked or replaced. Depending on the climate zone, different insulation thicknesses can be applied. In most cases, 15–20 cm is sufficient. Where extremely low temperatures are expected, insulation thicknesses of up to 40 cm may be required.

Regional Hemp Block Manufactories
Such a manufactory can be established regionally almost anywhere. In addition to the mixing area, consisting of a mixer, workbench, and wooden molds, sufficient space is required for drying the blocks. With a monthly output of around 20 m³ of hemp-lime, equivalent to 900 hemp-lime blocks (15 cm thick, 60 cm long, and 25 cm high), an area of about 200 m² is needed. (Fig. 3–6)

Sergiy Kovalenkov – Scalable Insulation Solutions from Hempire

Serhiy Kovalenkov is the founder of Hempire and a specialist in natural construction with over 15 years of experience working with hempcrete systems used in various climatic conditions and architectural contexts. His innovations have contributed to the recognition of hempcrete both in Ukraine and internationally. In 2014, he founded Hempire, a company specializing in the development and application of building materials based on industrial hemp and lime. With offices in Ukraine and the USA, Hempire has completed more than 200 hempcrete projects worldwide, including in various climate zones.

»The Fifth Element« is the innovative core of Hempire, a natural lime binder specifically designed for use in ecological hemp insulation materials
When combined with water and hemp hurds, it forms a lightweight construction material that is non-load-bearing but provides excellent thermal insulation. During curing, the material absorbs carbon dioxide from the air and gradually turns into natural limestone. This not only sequesters CO_2 but also creates a particularly durable and long-lasting building material. Ukraine has long been a global center of industrial hemp production and today offers optimal conditions for its cultivation. Hemp is usually planted in spring, harvested at the end of summer, then dried, broken, and separated into hurds and fibers. Previously, dried hemp stalks were broken using a special device, a breaker, and fibers were manually separated from the woody core (the hurds). Today this process is performed by machines that use combs, sieves, and vibrators to separate fibers from hurds. Long fibers are used for textile or bioplastic production, while hurds, due to their light and porous structure, are ideal as a thermal insulation filler for hemp-lime mixtures.

Hempcrete developed by Hempire is used in a wide range of construction methods:

- spraying onto walls using specialized equipment
- on-site casting in timber-frame constructions
- as prefabricated panel systems
- for the production of hempcrete blocks, with or without reinforcement
- for interior insulation of existing stone or concrete structures, including historic buildings.

✎




Fig. 9–12: Production and installation of hemp building materials: Mixing, compacting and filling hemp lime in timber frame constructions © Hempire



Fig. 13–15: Various building forms made of hempcrete, from cubic to vaulted structures in construction © Hempire

Fig. 16–18: Timber frame construction with hempcrete and hemp-lime infill in various construction phases © Hempire


Certification
Between 2019 and 2023, Hempire carried out all necessary testing and certification. The material is suitable for insulating concrete and stone buildings, including bomb shelters. This certification became an important step toward integrating bio-based building materials into official construction standards. Since the beginning of the war, Hempire has also supported reconstruction initiatives. In the Chernihiv and Mykolaiv regions, as well as in western Ukraine, the company organized workshops for internally displaced persons, showing them how to build independently using local and renewable materials. A striking example was the transformation of an abandoned farm into a residential and rehabilitation center for orphans and refugee families. Training lasted only two weeks (!) and people without prior construction experience were able to acquire the necessary skills to continue building the facility. As a co-founder of the US Hemp Building Association and president of the Ukrainian Hemp Building Association, Kovalenkov contributed to the development of the first building standards for hemp-lime constructions, promoting their official recognition. Hempire also provides training and consulting to dispel misconceptions about the use of hemp. All materials are supplied from Ukraine, although lime quality varies due to outdated production methods. Despite the lack of large limestone deposits, local suppliers can meet the needs of large projects.

Relevant for scientific research
Industrial hemp is capable of absorbing pollutants from soil. Hemp has been used for phytoremediation, including in classified tests near Chornobyl, where its ability to absorb heavy metals and toxic substances from soil was demonstrated. Although further research is needed to determine how these pollutants behave within the biomass, hemp remains a highly promising crop for reconstruction in war-damaged, contaminated, or marginalized areas.

Werner Schönthaler – Industrialized Hemp Blocks and Prefabrication

Werner Schönthaler, a building contractor, has transformed his family’s traditional concrete company in South Tyrol over the past fifteen years into a leading manufacturer of hemp-based building materials. Today, his company specializes in industrialized hempcrete blocks, plasters, acoustic panels, and prefabricated systems for scalable, low-carbon construction. Werner’s innovations have gained international recognition and positioned hempcrete as a key material for climate-friendly and regenerative architecture. In 2022, he was awarded the German Sustainability Award for Design.

Originally a conventional material supplier, the company shifted its production in response to the high ecological costs of standard concrete. Since then, its focus has been on hempcrete due to its specific qualities: abundant and fast-growing resources, suitability for insulating wall systems without synthetic insulation, adhesives, or multilayer constructions.

The main feature of hempcrete, however, is its ability to store CO_2 within the building envelope and actively contribute to climate protection.

The production site in northern Italy, near the Swiss and Austrian borders, offers ideal conditions: little rainfall, abundant sunshine, and steady winds ensure fast and natural curing of hempcrete. Thanks to adapted concrete machinery, large-scale production is now possible — up to 100 cubic meters of hemp blocks per day. This volume is necessary to remain cost-competitive with conventional building materials. Further process improvements — such as specialized mixing plants and new molds — have made production more efficient and improved access to the market.

Fig. 19: Hemp stones in different standard sizes: 6cm, 8cm, 12cm, 20cm, 25cm, 30cm, 38cm © www.hanfstein.eu

Fig. 20: Hemp blocks as external insulation © www.hanfstein.eu

Fig. 21: Prefabricated walls made of hemp and lime, Opening for a window © www.hanfstein.eu

Fig. 22: Hanfstein interior insulation © www.hanfstein.eu

Fig. 23: Wall made of hempcrete © www.hanfstein.eu

Fig. 24: Twisted Blocks elements © www.hanfstein.eu

Hemp blocks are now used in large-scale residential construction. In Italy, exterior walls are typically 38 cm thick, while in Switzerland and Germany the thickness has been increased to 45 cm to meet insulation standards. In climate zones with extreme cold and heat, such as Ukraine, even thicker hempcrete walls are recommended to ensure indoor comfort during power outages and to protect infrastructure such as water pipes from freezing.

Research Network

Schönthaler's collaboration with the University of Vienna has expanded into a research partnership with the University of Kyiv. There, researchers study the properties of hemp fibers and hemp shives. Ukrainian scientists are particularly interested in how these two materials can be combined in wall constructions — for local reconstruction or hybrid building systems. Specially tailored mixes are being developed and tested to adapt them to different building types and climatic conditions.

Reducing Costs

In addition to massive wall elements, the company has developed prefabricated systems that allow for fast assembly and delivery at fixed costs. One structure was erected in just a few weeks to demonstrate the speed and predictability of this approach. Prefabrication improves workflows on-site and reduces the need for complex logistics and specialized labor, making it particularly suitable for use in remote or disaster-affected areas. This also significantly lowers costs.

Acoustic Panels

Another innovation is the development of acoustic panels, available in five geometric configurations and ten color variants. These panels have undergone rigorous testing for sound absorption and fire resistance, including as part of a student master's thesis at Tel Aviv University. Thanks to their light weight, flexible design, and ecological properties, they are suitable for use in public, commercial, and educational buildings.

Natural Cooling Properties

The natural cooling properties of hempcrete are especially advantageous in southern European regions: at outside temperatures of 35 to 40 °C, indoor temperatures can be reduced to around 25 °C without air conditioning. Hemp buildings with timber frames require less wood while still offering high stability and ensuring a comfortable indoor climate.

Beehive Research

Schönthaler also thinks beyond human housing, developing prototypes for beehives. Commissioned by ETH Zurich, the project aims to explore how hemp materials can help protect habitats for pollinators such as bees, an immensely important issue in times of dramatic biodiversity loss caused by climate change. These small structures are currently being studied for their ability to store heat and regulate the microclimate for sensitive insects.

Education for Future-Proof Building

Through targeted workshops in cooperation with the University of Graz, architecture faculties, and public education programs, the educational work goes beyond simple knowledge transfer. The goal is to demystify hempcrete, stimulate interdisciplinary research, and raise awareness among both professionals and the wider public about nature-based, regenerative building systems.

In the spirit of future-proof building, construction that remains ecologically, socially, and economically sustainable for generations to come, the aim is to promote fundamental change in the building industry.

HOPE HOME• НАДІЯ Field Report – Recipes

Workshop in Pervomaiske, Ukraine

~40 km east of Mykolaiv (on-site: May 27 – June 6, 2025)

Notes:

- **Lime-Hemp Mix:** It's essential to follow the mixing order in a tumble mixer: water first, then lime, then hemp. Initially, there was a mix-up with a pre-mixed hemp-lime finish from Hempire, which lacked adhesive strength. Nonetheless, the 15 cm blocks hardened on the surface after a week.

Mortar Recipes

Specified in RT = room parts	Lime-Hemp	Repair Mortar / Patch Plaster	Lime-Hemp-Sand Plaster	Clay-Straw Patch Plaster
Lime (5th Element / Hempire)	1	1	1	
Hemp shiv	3–3,5	2	1,5	
Clay				1
Straw				approx. 1,5
Sand			1,5	
Water	approx. 1	approx. 1	approx. 2	approx. 0,75


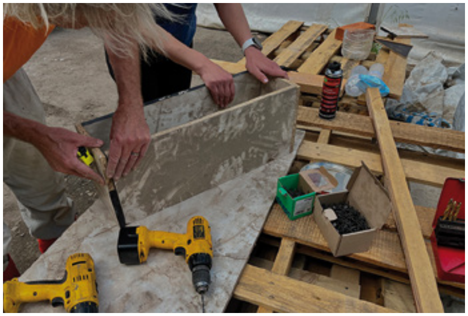


Fig. 25–27: Workshop May-June 2025 on the production of hemp building blocks © HOPE HOME • НАДІЯ

- **Repair Mortar (Patch Plaster):** Effective for small fixes, filling empty sockets, and especially useful after removing mold in previous phases.
- **Lime-Hemp-Sand Base/Top Coat:** Works very well, can be thrown with a trowel. Ukrainian hemp shiv is on the shorter side (~15mm) with short fibers, but they don't interfere. It's important to smooth the plaster quickly with a wooden float.
- **Clay-Straw Patch Plaster:** The clay is high in clay content and was soaked in a metal tub. Straw was added by feel and then cut/grated manually along the edge of the tub. The mortar is very sticky and not easy to smooth; it can be softened with sand. It hardens quickly and may develop small shrinkage cracks and some white mold (fungus).
- A **hemp-lime finish coat** from Hempire was also applied over the clay patch layer. This finish is meant as a design topcoat, but when used as a leveling layer it showed shrinkage cracks (~20cm spacing) after half a day.
- A **lime wash** was brushed over the clay patch using a 1:5 lime-to-water ratio. For better translucency, use more diluted mixture and apply 2 coats. (Fig. 25–27)

Safety Instructions:

Lime is highly alkaline (classified as Xi)!

Use mouth protection, eye protection, apply cream to the skin, have eye rinse ready, and keep a mild neutralizer nearby (e.g. lemon juice, apple juice, Coca-Cola…).

A 0.9% saline solution is an effective eye rinse and is available in ampoules at any pharmacy.

Clay © HOPE HOME • НАДІЯ Material Show, Kyiv 2025, Natalia Azarkina

Clay, Wood, Natural Fibers and Circular Construction

Clay is a natural building material composed of a mixture of sand, silt, and clay minerals. These three components are found in varying proportions in almost all soils worldwide. Soil rich in clay can often be sourced directly from excavation sites or agricultural land — a clear advantage in terms of transport distances, carbon footprint, and circular potential.

Working with clay requires a shift in mindset compared to industrial building materials: it is typically applied in a moist state, for example, as rammed earth, clay plaster, adobe bricks, or lightweight clay (mixed with fibers). Once dried, clay hardens again but remains reversible, meaning it can be reshaped or recycled with water without any loss of quality.

Clay unites ecology, building culture, and material circularity, and is once again at the forefront of low-carbon construction. Particularly in hot climates such as southern Ukraine, thick clay walls have long provided pleasantly cool indoor environments.

Fig. 1, 2: JEUX D'ADOBES, Workshop, Creation of Educational Content © M.A.M.O.T.H.

Fig. 3: 3D constructions © TECLA

Traditionally, construction in the region used what was colloquially referred to as saman (clay bricks) — a local blend of earth, clay, and fibers such as hemp and straw, often combined with materials like reed or thatch.

This approach was not only functional but remains deeply rooted in local resources, artisanal knowledge, and cultural practices.

Sofia Galat – Introduction

Project management and Co-Curator of HOPE HOME • НАДІЯ, UA. She teaches at KNUCA (Kyiv National University of Construction and Architecture) and is pursuing a PhD in biomimetic architecture.

Historical Background
Constructions made from clay and sand have proven to be durable and practical over thousands of years. As a widely available material in rural areas, clay has been used for more than 6,000 years, beginning with the early civilizations. In Mesopotamia, one of the cradles of civilization, clay, natural cement, and other materials were used to build houses and surrounding infrastructure. In Ukrainian culture as well, clay has played a central role in construction since early times, as it is a traditional building material that has stood the test of centuries, is reusable, and has been passed down through generations as part of local building knowledge.

Traditional Use
In many cultures, walls and ovens have been — and still are — built using a mixture of clay and natural cement. These materials offer:

- excellent insulation and summer heat protection
- local availability
- environmental friendliness.

Especially in rural areas, clay has long been, and continues to be, a crucial building material due to its natural properties, such as thermal mass and moisture regulation. Today, clay and earth as construction materials are experiencing a true renaissance. (Fig. 1–3)

Earthen Construction – More Relevant Than Ever

- Clay bricks and blocks are produced in various shapes to explore how they can be used even more efficiently.
- Rammed earth is a widely used technique in which pneumatic rammers are employed to compact the material as much as possible, thereby ensuring structural stability.
- The most innovative approach involves 3D-printed structures, using a mix of 95 percent clay and 5 percent natural additives. The printing time for the structure shown in Fig. 3 is approximately 100 hours.

Eike Roswag-Klinge and Julian Mönig – Research and Projects at the Natural Building Lab, Berlin

Eike Roswag-Klinge, Professor of Building Construction and Climate-Adaptive Architecture at the Institute of Architecture at TU Berlin since 2017, head of the Natural Building Lab, Berlin.

Julian Mönig, research associate at the Natural Building Lab, Technische Universität Berlin and the University of Applied Sciences Northwestern Switzerland.

Natural Building Lab
An interdisciplinary department for design and construction at the Institute of Architecture, specializing in design-build projects. It is a transdisciplinary institution for students working on practice-oriented projects and in real-world laboratories, where materials are developed, tested, and directly experienced in architectural applications. The focus is on sustainable building, especially using natural materials such as clay and other natural building products, as well as research.

Focus: Natural Building Products
At the NBL, natural building materials are thoroughly examined in scientific studies for their suitability in creating healthy indoor climates. Since the 1980s, empirical studies have confirmed the significant role of materials such as clay and natural fibers in supporting healthy interior environments.

Focus: Research
Development and certification of clay-based building materials, timber constructions, and natural fibers as integral components of a holistic construction system.

Where does clay come from?

- The base material clay is formed in mountain regions through cycles of freezing and thawing.
- Natural erosion processes carry the material downward, where it is further broken down along the way.
- Clay consists of various grain sizes, including sand, silt, and clay (as a binding agent).
- Clay can be reused almost indefinitely as long as it remains within the natural material cycle. Its natural composition varies: depending on its makeup, different applications and techniques become possible. (Fig. 4)

Why Clay is Convincing

- Natural building materials such as clay, wood, and natural fibers have a positive effect on indoor humidity and thus on health: various studies consider a relative humidity of 40 to 60 percent to be effective in preventing the spread of viruses and mold. (Fig. 5)
- Clay plaster possesses a fine capillary system that enables it to absorb and release water vapor from humid air. This property makes it particularly effective at regulating indoor humidity levels.
- The crystalline structure and clay content allow for rapid moisture absorption and release: in humid air, clay absorbs moisture; in dry conditions, it releases it again. This ensures a healthy and comfortable indoor climate by keeping humidity levels constant.

✎

Fig. 4: Components of clay
© https://lehm-in-farbe.de/was-ist-lehm/

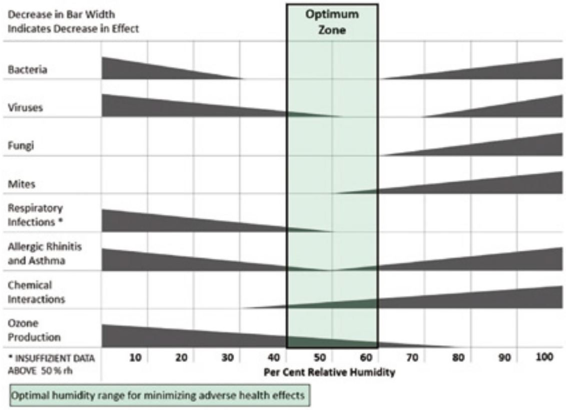

Fig. 5: Effect of relative humidity on indoor air quality © Dry climate evaporative cooling with refrigeration backup, C. Mike Scofield and Elia Sterling in ASHRAE Journal (American Society of Heating, Refrigerating and Air-Conditioning Engineers), 1992

Fig. 6: Climate chamber
© Natural Building Lab

Fig. 8: Teachers' Housing, Rudrapur, Bangladesh
© ZRS Architects Engineers

Fig. 7: Meti School Handmade, Rudrapur Bangladesh © ZRS Architects Engineers

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- Various studies confirm that the indoor temperature in massive clay houses remains significantly more stable in summer compared to concrete buildings. While concrete structures often overheat or lag behind the outdoor temperature, clay buildings can remain up to 10 °C cooler than the peak external temperature.

Testing the Moisture Regulation Capacity of Building Materials

A typical method for assessing the moisture absorption capacity of building materials is testing in a climate chamber, where humidity and temperature can be precisely set and controlled.

The chamber is adjusted to a relative humidity of 50% and a constant temperature of 23 °C. The material samples, such as clay plaster or wood, are preconditioned until they reach a stable mass. After this, the materials (e.g., clay plaster, wood) are exposed to a higher humidity level of 80%, and the moisture absorption process is observed at specific time intervals.

A precision scale is used to measure how much moisture the material can absorb during this period.

The amount of moisture absorbed, and the time required, provide insights into the material's moisture capacity and hygroscopicity — that is, how well a building material can absorb and release humidity.

DIN 18947 classifies materials according to their ability to absorb water vapor. Materials that absorb more than 60 grams per square meter meet the highest standards and are considered particularly climate-active.

These requirements apply to clay building materials, straw fibers, wood, wood-based insulation materials, and wood fiber insulation boards, all of which have proven to be especially climate-adaptive. (Fig. 6)

Previous Projects Using Straw–Clay–Bamboo Techniques

- The Meti Handmade School in Rudrapur, Bangladesh, was built by local craftsmen using cob construction, a clay and straw mixture, for the ground floor, and a bamboo structure for the upper floor. Directly adjacent to the school, a Teachers' House was constructed. The ground floor was built using brick masonry, while the upper floor features a timber-frame structure made of bamboo, filled with a clay-straw mixture and clad in a bamboo façade.
- As part of the Beehive project, students developed an exhibition structure made of bamboo and clay, designed to be 100 percent reusable and constructed in the form of a beehive. The clay bricks were air- and sun-dried, a process that took about one week. Initially, the bricks were laid flat on the ground and the molds were removed immediately (similar to the production of hempcrete blocks). After an initial drying phase, the bricks were flipped and stood upright to continue drying vertically. The floor tiles were prefabricated in a similar manner and dried in the open air. On-site assembly took one week. The entire installation was later dismantled cleanly by material type, without generating any waste. (Abb. 9,10)

It is conceivable that in Ukraine, a shade tent might be necessary to prevent the bricks from being scorched by excessive sun exposure

- »upMIN 100«, an ongoing research project, explores whether recycled mineral aggregates are suitable for use in earthen building materials. Provided that specific limits for contaminants are observed, the project has been able to demonstrate technical feasibility. (Fig. 11,12)

Conclusions from the projects

The 5 basic principles for ecological (re)construction

- Reduction of glass surfaces to limit heat absorption
- Use of natural insulation materials for effective thermal protection, especially in summer
- Application of hygroscopic, moisture-regulating materials to control indoor humidity

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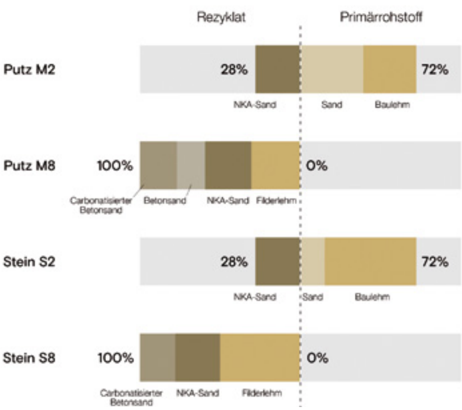
Fig. 9: Beehive, Gropius Bau exhibition (2022) YOYI! Care, Repair, Heal © Natural Building Lab

Fig. 10: Beehive © Natural Building Lab



upMINI100
CHALLENGES
Construction sector in Germany

- 55 % Construction and demolition waste > over 230 million tons (2019)
- 92 % Use of mineral raw materials > over 517 million tons/year
- 40 % CO_2 Emissions

Fig. 11, 12: upMINI100 © Graphic: Natural Building Lab, © Photo: ZRS Architects Engineers

Fig. 13: Clay decorative plaster © Glinko

Fig. 14: Processing procedure with clay decorative plaster © Glinko

- Cooling with cold night air to lower summer temperatures, passive cooling saves energy
- Cross ventilation, with openings on opposite sides, helps remove trapped heat

This is the direction we need to go!

- No more new buildings
- Reduced per capita land use
- Preserve resources, minimize spatial and resource consumption
- Improve existing building stock, stop demolitions
- Redesign cities, infrastructures, and urban landscapes
- Expand the market for natural products
- Link the built environment with organic agriculture and forestry to strengthen a building culture based on combinations of straw, hemp, wood, and natural fibers
- Expand the market for natural products
- Link the built environment with organic farming and forestry
- Strengthen building culture using combinations of straw, hemp, wood, and natural fibers.

Big Picture: Principles of Low-Tech Construction:
easy to implement _ applicable internationally _ in line with the fundamental requirements of sustainable architecture.

Sergiy Shertsnyov – Business Example

He is the founder and head of the company Glinko, based in Kyiv. He builds using clay and earthen materials and offers seminars and consultancy services on these materials and techniques.

- »Glinko« is derived from the Ukrainian words for »clay« and »company«
- Production of various types of clay plaster, as well as blends of sand, hemp, and straw-clay mixtures
- Clay panels for houses made of hemp and straw, as well as compressed earth blocks
- Natural colors without chemical pigments are created from native Ukrainian clay and sand. These hues result from the diverse soil compositions found across the region. In southern Ukraine, for example, the »royal color« is a clay plaster mixture of clay, straw, and wheat that shines golden in the sun.

Why use clay as a building material?

- Simple Production
  Clay requires no complex, energy-intensive manufacturing processes — it is directly available from nature and can be used immediately.
- Ecological and Sustainable
  An environmentally friendly raw material with a minimal CO_2 footprint, both in extraction and processing.
- Healthy Indoor Climate
  Creates a pleasant indoor microclimate, promotes well-being, and contributes to healthy air quality.
- Natural Climate Regulation
  Regulates humidity and temperature naturally — without the need for technical systems.
- Environmentally Friendly in Deconstruction
  Clay poses no environmental harm during use or disposal, it is entirely residue-free and can be seamlessly reintegrated into the natural cycle.
- Versatility and Protection
  Clay offers excellent thermal and acoustic insulation, and even provides shielding against electromagnetic radiation.

Fig. 15: Construction phase © Geodesic.Life
Fig. 16: Affordable prefabricated eco-friendly dome houses © Geodesic.Life

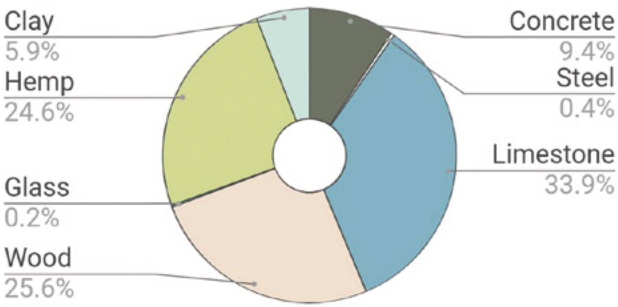


Fig. 17: Use of natural materials © Geodesic.Life

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Clay in combination with straw and hemp

- Ideal for Straw and Hemp Houses
- Clay plaster is an excellent surface finish, particularly in combination with straw, which helps regulate temperature and allows for proper ventilation.
- Strong Bond
- Clay and hemp form a perfect match — the clay serves as a natural binder, while hemp acts as a lightweight, porous filler. Together, they create a healthy indoor climate, effective thermal insulation, and natural humidity regulation.
- Natural Partition Walls
- The combination of clay and straw panels is ideal for interior and partition walls, especially in ecological building projects.
- Clay Blocks as a Brick Alternative
- Our standardized clay blocks (65 x 120 x 250 mm) are lightweight, dry quickly, and do not require firing — a resource-saving and environmentally friendly alternative to conventional bricks.

Eugene Kuzmenko – Startup Example

UA, founder of the startup Geodesic Life, focused on designing and building dome houses using natural materials such as clay, wood, and hemp in Ukraine.

Initial Problem 1:
Energy-efficient construction is a challenging task.

Modern methods of erecting energy-efficient buildings are based on multi-layered structures, several inseparable functional layers, each serving its own purpose: load-bearing capacity, thermal insulation, moisture protection, and sound insulation.

At the end of a building's life cycle, these composite layers are difficult or impossible to separate, making recycling virtually unattainable. This significantly worsens the ecological footprint.

One of the few, and non-environmentally friendly, ways to reuse such building composites after dismantling is to mix them with cement(!), level the mixture, and use it for road construction. But do we really need that many roads?

Initial Problem 2:
The population density in many cities is extremely high.

More and more people are moving to cities for career opportunities, but available space is becoming increasingly scarce.

The surplus of residential buildings with high rental costs and minimal living space leads to a decline in quality of life and a growing imbalance between housing supply and demand. In contrast, the market for environmentally friendly, energy-efficient homes remains small. (Fig. 15, 16)

Development of Geodesic Life

Generation 1:
The first energy-efficient dome house, built in 2019, consisted of 105 triangular surface elements.

Cost per m²: 450 USD

Drawback: labor-intensive finishing of the joint lines between the elements.

Generation 2:
The design was simplified to 29 elements using the prefab method.

Cost per m²: 1,200 USD

Drawback: expensive interior and exterior finishing of the roof and walls.

Generation 3:
The entire structure is made of CLT wood using the prefab method.

Advantage: accelerated building assembly in any weather; CLT walls and ceiling require no additional finishing; up to 73 % of materials are suitable for reuse in reconstruction.

Conclusions and Outlook:

The next generation of Geodesic Life will focus on creating small settlements and villages consisting of dome-shaped houses. There will be an increased use of natural materials, such as wood, hemp-lime insulation, clay plaster, and green grass roofs. A hybrid passive ventilation system will be used, which does not require additional air ducts: the living system will automatically open and close windows and control CO_2 levels, without the need for extra ventilation channels (Fig. 17)

Leon Zimmermann – Material Studies with Clay and Fibers

Research Associate, TU Braunschweig, Institute for Building Climatology and Energy of Architecture

Leon Zimmermann has explored through various experimental studies which natural fibers can be combined with clay — not only those that are ecological but also easily available. Some of the materials come from waste products, such as old coffee sacks or raw wool.

DIY instructions also well suited for use on construction sites

Can a clay table carry heavy loads?
Yes! A table made of clay and jute fabric successfully withstood a load of 230 kg. Thanks to its special geometry and the combination of clay with natural fibers, the clay table has a surprisingly high load-bearing capacity. The clay provides strength, while the folded jute fabric adds additional stability.

With sufficient preparation time, a clay table becomes a practical and robust work tool that proves itself even on construction sites.

Instruction:
1. Cut old coffee sacks into strips 40–60 cm wide.
2. Mix clay with water until a liquid clay slurry is formed.
3. Build a zigzag-shaped mold from wooden boards.
4. Fully immerse the jute strips in the clay slurry until they are evenly soaked.
5. Place the strips layer by layer into the mold, at least eight layers.
6. Let the construction dry for 14 days in a well-ventilated, shaded place.
7. Carefully remove the mold and place a suitable wooden board on top of the tabletop.

How to Build a Stable Wall from Clay
With clay folding, it is possible to quickly construct a stable wall made of clay and natural fibers. The wall system can be built vertically or horizontally as needed. By folding and layering jute strips soaked in clay, a load-bearing structure is created that is both stable and durable.

Instructions:
1. Mix clay with water to create a clay slurry.
2. Cut open coffee sacks and cut them into strips 40–60 cm wide.
3. Build a mold from wooden boards in the shape of a right angle.
4. Thoroughly soak the jute strips in the clay slurry.
5. Place at least eight layers into the mold one after another.
6. After 14 days of drying, carefully remove the mold.
7. Set up several right-angle elements and place them next to each other. Insert small wooden blocks between the elements, drill through, and fasten with screws and nuts.

Insulating Bricks Made of Clay?
By combining clay, jute, and raw wool, these bricks offer not only good thermal insulation but also high strength. The raw wool provides additional insulating capacity, while the clay ensures stability.

Instruction:
1. Mix clay with water to create a clay slurry.
2. Cut coffee sacks into strips 40–60 cm wide.
3. Build wooden molds in various angled shapes, depending on the desired brick size.
4. Dip the jute strips into the clay slurry and lay them in the mold layer by layer, at least eight layers.
5. Let the form dry for 14 days, then remove it from the mold.
6. For the side walls, prepare extra panels from jute-clay strips and dry them separately.
7. Set up the panels and loosely fill the gaps with raw wool.
8. Finally, wrap the entire brick with clay-soaked jute strips. Allow to dry thoroughly until the brick is stable.

How Can the Strength of Clay Bricks Be Increased?
Combining clay with natural fibers such as hemp or wool prevents the bricks from breaking and increases both compressive strength and flexural strength. This way, the bricks can be made not only stronger but also more flexible.

A research project in central Romania focuses on studying the impact of different natural fiber additives on the mechanical properties of clay in order to specifically improve its suitability for brick production.

The results so far are impressive: with only 0.2 % hemp fibers, compressive strength increases by 55 %; with 0.2 % wool fibers, flexural strength increases by 25 %.

Instruction:
1. Mix clay with water and possibly some sand into a firm, damp-earth-like mixture.
2. Loosen natural fibers such as hemp, wool, or nettle and mix them in, about 0.2 % by weight.
3. Build a mold for the bricks from wooden boards.
4. Throw the mixture energetically into the mold to create dense layers.
5. Compact the material well with a board or hammer and smooth the surface.
6. Carefully remove the bricks from the mold and store them in the shade on wooden slats, so that air can circulate on all sides.
7. Turn the bricks regularly during drying to prevent cracks.
8. After complete drying, at least 14 days, the bricks are ready for construction.

Fig. 18: Jute coffee sack
© Leon Zimmermann / Institute for Architecture-Related Art, TU Braunschweig

Fig. 19: Coffee sack soaked in clay
© Leon Zimmermann / Institute for Architecture-Related Art, TU Braunschweig

Fig. 20: Load test of a wool-clay-jute fold with over 230 kg
© Leon Zimmermann / Institute for Architecture-Related Art, TU Braunschweig

Fig. 21: Clay-soaked jute sacks on formwork and finished element © Leon Zimmermann / Institute for Architecture-Related Art, TU Braunschweig

Fig. 22: Wall element made of clay and jute with fasteners
© Leon Zimmermann / Institute for Architecture-Related Art, TU Braunschweig

Fig. 23: Building block made of clay-jute folded and insulated with raw wool © Leon Zimmermann / Institute for Architecture-Related Art, TU Braunschweig

Fig. 24: Finished clay insulation block © Leon Zimmermann / Institute for Architecture-Related Art, TU Braunschweig

Fig. 25: Clay brick in formwork and switched off © Leon Zimmermann / Institute for Building Construction, TU Braunschweig

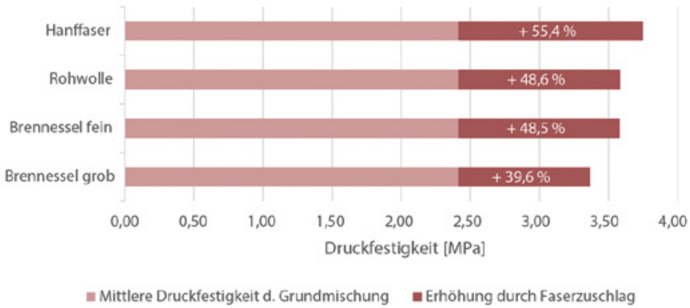

Fig. 26: Influence of natural fibers on the compressive strength of clay bricks
© Leon Zimmermann / Institute for Building Construction, TU Braunschweig

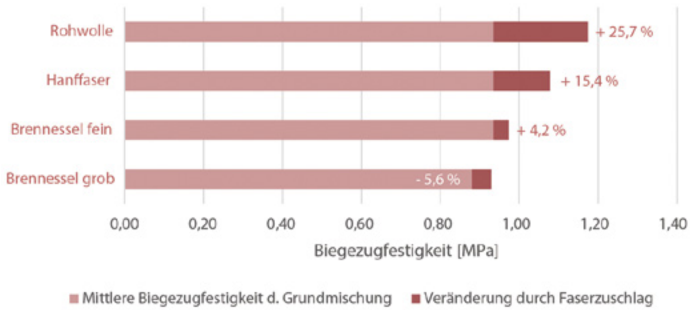

Fig. 27: Influence of natural fibers on the flexural strength of clay bricks
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Straw © HOPE HOME • НАДІЯ Material Show, Kyiv 2025, Natalia Azarkina

Straw

Before the full-scale invasion, the Mykolaiv region was regarded as one of Ukraine's key centers for straw panel production, owing to its strong agricultural base and well-developed logistics. The region supported several active workshops supplying eco-friendly building materials for use across the country. However, since 2022, this productive landscape has been severely disrupted. Many facilities have either shut down or are operating at reduced capacity due to infrastructural damage, labor shortages, and disrupted supply chains.

Compounding the industrial challenges is a sharp increase in agricultural fires. According to Climate Focus, the number of fires in Ukraine rose during the first year of the war, damaging extensive areas of farmland. While many fires are caused by military activity, a significant portion is intentionally set by farmers and landowners who burn straw fields after harvest. This practice, driven by the fact that burning is cheaper and faster than collecting and transporting straw for other uses, has resulted in a notable decrease in the availability of straw for construction, while also contributing to air pollution and soil degradation.

Fig. 1, 2: Straw building blocks © Oleksii Brusnitsyn

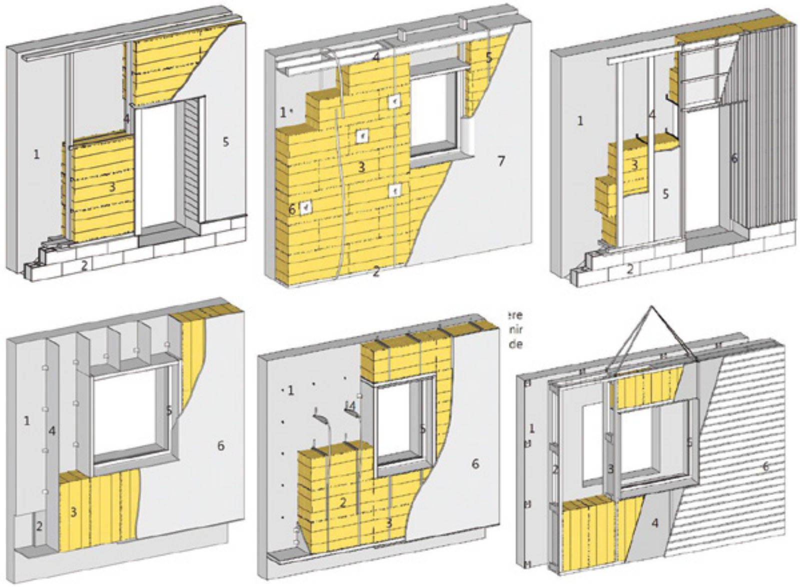

Fig. 3: Construction drawing © Olexsii Brusnitsyn

Fig. 4–6: An example: Atelier Werner Schmidt is a Swiss architecture firm specializing in sustainable building with natural building materials such as straw and wood, designing thermally efficient, low-energy buildings © https://www.atelierschmidt.ch/oekologie

Despite these challenges, experts and organizations continue to explore and promote straw as a high-performance, low-carbon building material. Deeply rooted in the region's architectural history, straw has long been used in traditional Ukrainian construction, particularly in rural areas, where it was readily available and valued for its natural insulation. Today, its thermal efficiency, fire resistance, local abundance, and renewability position it once again as one of the most promising materials for energy-efficient, climate-resilient architecture, a role that is especially critical in the context of Ukraine's reconstruction and sustainable development.

Olexsii Brusnitsyn: Building Materials and Structures Made of Straw, Wood, and Clay

Olexsii Brusnitsyn has dedicated his work to the advancement of sustainable building practices in Ukraine. His focus has been on developing alternative wall compositions, such as finely chopped straw blown into wooden-framed walls, to enhance thermal insulation and fire resistance. This method creates a seamless, high-density thermal barrier, improving building durability. When properly treated and coated with clay or lime plaster, compressed straw achieves an F90 fire resistance rating, meaning it can withstand fire for up to ninety minutes. (Fig. 1, 2)

Life Cycle Assessment (LCA) data on straw-based construction highlights clear environmental advantages over conventional insulation systems. Straw walls require approximately 3.5 times less primary energy for production than mineral wool systems offering equivalent thermal performance. In terms of carbon emissions, straw-based components demonstrate a negative global warming potential, sequestering more CO_2 over their life cycle than they emit. Performance indicators show that straw construction consumes just 45 kWh/m² of energy, with a greenhouse gas impact of –38 kg CO_2 eq./m², positioning it firmly as a climate-positive building solution.

One of the critical bottlenecks in expanding the use of this material lies in the current production landscape. Out of eight identified manufacturers of straw panels in Ukraine, only 5.5 are fully operational, with the remainder facing capacity issues due to logistical disruptions, labor shortages, or infrastructural limitations. Combined, these facilities produce roughly 6,600 square meters of panels per month. Given that a typical residential structure of 120–150 m² requires between 150–200 square meters of straw panels, this output translates to just 40–50 house kits monthly, or approximately 600 per year.

Despite its high environmental performance and a production cost of around 55 EUR per square meter, straw construction remains a niche industry. Most manufacturers are currently focused on producing wall panels, rather than offering comprehensive building systems, limiting scalability and broader adoption. (Abb. 3, 4)

Figs. 7, 8: The »querbeet« community housing project in Lüneburg © Dirk Scharmer

Figs. 9, 10: Straw-insulated wall elements © Adrian Nägel

Adrian Nägel – Standardization and Technical Innovations

Adrian Nägel, architect specialized in sustainable renovation and straw-insulated timber buildings, has made contributions to the development of straw-based construction in Germany. As an activist at Architects for the Future and a professor at the Technical University of Berlin, his work focuses not only on technical advancements but also on the political and regulatory changes necessary in the construction industry toward climate neutrality. He actively participates in multiple straw-building projects, including one of the largest straw-insulated residential buildings in Germany, a four-story flat complex with 40 housing units that has already been completed and occupied. (Fig. 7, 8)

Straw is widely recognized as a practical and accessible construction material. As an agricultural byproduct, it is readily available and requires minimal processing before being used in building applications. Unlike timber, which takes decades to mature, straw is harvested annually, making it a rapidly renewable and highly sustainable resource. Its use in construction not only lowers carbon emissions but also contributes to carbon sequestration, resulting in a climate-positive material profile.

Straw also offers excellent thermal insulation properties, with a thermal conductivity of approximately 0.049 W/(m·K). Its ability to regulate indoor temperatures helps keep interiors warm in winter and cool in summer. Additionally, straw's high heat storage capacity helps prevent overheating, making it suitable for regions with significant temperature fluctuations.

Load-bearing straw bale construction is a traditional method where compressed straw bales serve both as structural and insulating elements. Originating in Nebraska in the late 19th century, this system involves stacking bales like bricks within a framework, with wooden ring beams providing structural stability at floor and roof levels. Standard wall thicknesses are approximately one meter, offering effective insulation and acoustic buffering. In this system, straw bales typically come in two size formats, depending on the project design. Wooden ring anchors distribute the structural load evenly, creating a monolithic, breathable envelope.

Despite its strong performance, load-bearing straw bale construction in Germany is subject to regulatory limitations. Current codes restrict its application to buildings of no more than two stories, and each project must receive individual approval due to the absence of a standardized certification pathway. This has limited its scalability for larger or urban developments.

By contrast, non-load-bearing straw bale construction, where straw is used solely as insulation within a timber frame structure, has gained broader acceptance. This method is formally recognized under European Technical Assessment (ETA) 017-0247, allowing for use in buildings of up to five stories under current regulations. It offers greater design flexibility and easier approval processes. The German Straw Bale Building Association has played a central role in obtaining these certifications and continues to push for regulatory progress, including official recognition of load-bearing systems. (Fig. 9, 10)

In non-load-bearing straw construction, a timber framework is erected first, and compressed straw bales are inserted between the structural elements to form insulated wall assemblies. Standard bale dimensions are approximately 36 x 48 cm, with adjustable heights ranging from 80 to 120 cm to suit various design needs. This method is applied not only for walls but also for roof and floor insulation, although current German regulations do not permit straw-based flooring in multi-story buildings due to fire classification constraints.

A key advantage of this approach is its scalability. In Germany, straw-insulated timber-frame structures can be built up to five stories, making the system suitable for

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Fig. 11, 12: Industrially prefabricated straw-insulated modules
© www.ecococon.eu, www.lorenzsysteme.de, https://halm-haus.de/

Fig. 13–15: Lime plaster applied directly to straw walls © Adrian Nägel

urban residential and mixed-use developments. However, for buildings in higher regulatory classes, exterior walls must comply with non-combustibility requirements, as organic materials like straw are classified as combustible by default. Exceptions are made only when materials meet certified fire safety standards.

Prefabricated straw panel systems have been developed in collaboration with specialized manufacturers such as EcoCocon and Lorenz GmbH. These high-performance elements, with thicknesses ranging from 18 cm to 40 cm, offer multiple benefits:

- Rapid assembly, allowing houses to be built within a few days;
- Reduced timber use, as the structural framework is minimized;
- High insulation performance, with U-values as low as 0.12 W/m²K, meeting criteria for Passive House certification;
- Fire resistance, with panels achieving ratings of up to REI 120, suitable for buildings requiring enhanced safety measures.

The finishing process is another important feature of non-load-bearing straw construction. Unlike conventional insulation systems, straw walls do not require plastic membranes or vapor barriers. Instead, surfaces are finished with clay plaster on the interior and lime plaster on the exterior, creating a breathable and airtight envelope. These natural plasters act as the primary air-sealing layers, eliminating the need for synthetic tapes, foils, or adhesives, and supporting a healthy indoor climate through moisture regulation. (Fig. 11, 12)

The importance of precision in construction, particularly for electrical installations in straw walls. Since straw is a dense natural material, all electrical outlets and conduits must be carefully enclosed with clay plaster to ensure safety. For projects requiring increased efficiency, prefabrication offers a promising solution. Prefabricated straw elements can either be pre-plastered or temporarily wrapped in protective plastic to shield them from moisture during transport. Once delivered to the construction site, they are assembled and finalized with a second layer of clay or lime plaster. (Fig. 13–15)

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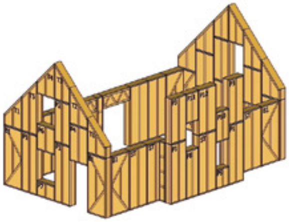

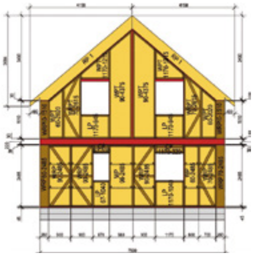

Fig. 16, 17: Construction drawing
© Artem Ryzhkov

Fig. 18–20: Industrially prefabricated straw-insulated modules © Artem Ryzhkov, Life House Building

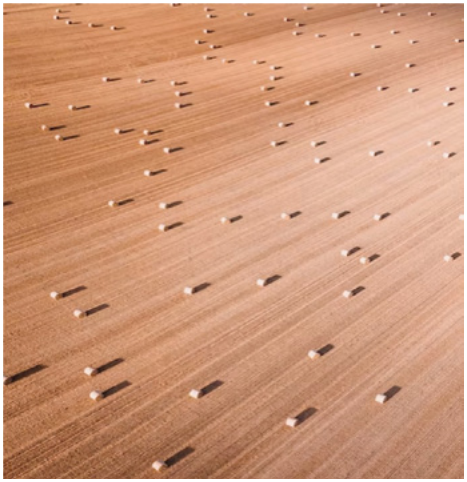

Fig. 21–23: Industrially prefabricated straw-insulated modules © Artem Ryzhkov, Life House Building

Artem Ryzhkov – Prefabrication and Modular Straw Construction

Life House Building founded in 2012, began with the construction of a straw house that laid the foundation for a scalable model of sustainable housing across Ukraine, including Crimea. The company initially applied traditional techniques, filling timber frames with straw bales and finishing both sides with clay plaster. Construction followed a carefully sequenced process to avoid moisture exposure, ensuring that roofs and windows were installed prior to the straw infill.

By 2013, LHB had begun to industrialize its process, setting up a dedicated workshop with equipment for compressing straw bales. Continuous optimization of the production system led to a marked increase in output, and within eight years, 65 straw houses had been completed across the country. In 2018, the company received national certification, enabling the export of its prefabricated components to the European Union—a key milestone that confirmed compliance with international standards.

Between 2019 and 2022, production was relocated to a site near Kyiv, facilitating the construction of an additional 63 homes, including Ukraine's first three-story straw house. These projects incorporated Svarog panels, modular, factory-produced elements made from compressed straw, clay, and wooden frames. Engineered for fast, on-site assembly, the panels offer a scalable and efficient alternative to traditional construction methods, allowing for high-performance, energy-efficient housing built in significantly less time than conventional systems.

The outbreak of war in 2022 halted domestic production. To maintain operations, part of the manufacturing was relocated to the Czech Republic under the name Svarog, continuing the development of straw-based prefabrication while securing EU certifications for the technology. This move preserved production capacity and supported cross-border knowledge transfer.

Plans are now in motion to return production to Ukraine. By leveraging technological advancements and industry experience gained in Europe, Svarog aims to reestablish local manufacturing using regional raw materials. This strategy reduces dependence on imported building components and strengthens the viability of straw-based solutions for reconstruction and sustainable development.

Straw, clay, and wood have long been part of Ukrainian vernacular architecture. Through modernization and industrial scaling, Svarog has established a system that merges traditional materials with contemporary performance requirements. Key advantages of this approach include:

- Increased Production Capacity: Up to 2,000 m² of panels per month, or 24,000 m² annually, can be produced using the current setup.
- Locally Sourced Materials: Regional straw and wood reduce logistics, emissions, and costs.
- Minimal Carbon Footprint: Buildings constructed with Svarog panels have a net negative CO_2 balance, storing more carbon than they emit across their lifecycle.

Compared to conventional building materials, prefabricated straw panels offer significantly lower embodied energy and greenhouse gas emissions, while maintaining high insulation performance and compatibility with modern construction practices. (Fig. 16, 17)

Comparative studies highlight the superior environmental performance of straw-based homes when measured against conventional building materials:

- Brick and concrete houses emit 42,000–45,000 kg of CO_2 per unit.
- Wooden houses emit 25,000–28,000 kg of CO_2 per unit.
- Straw-based homes have a drastically lower carbon footprint of 16,000–18,000 kg.

Beyond carbon emissions, straw construction reduces energy demands for heating and cooling. Traditional buildings require 160–180 days to construct, while straw homes can be assembled in just 45–60 days, offering a cost-effective and time-efficient alternative. (Fig. 18–23)

Fig. 24, 25: Energy-self-sufficient house made of straw © Katrin Puetz

Fig. 26–28: Garden biogas plant © (B)energy

Katrin Pütz – Off-Grid Living with Straw and Biogas

Katrin Pütz is one of several professionals working to reintroduce natural building materials into contemporary architecture as part of a broader movement toward sustainable and self-sufficient living. Her work bridges traditional craftsmanship with modern performance requirements, demonstrating how straw, clay, and wood, materials used in construction for centuries—can meet current standards for insulation, durability, and environmental resilience.

A key case study is her off-grid house, designed and built with a classic timber-frame structure. Straw bales are densely packed between wooden studs to form breathable, high-performance walls. Interior surfaces are finished with clay plaster, offering both moisture regulation and fire protection, while contributing to indoor air quality. Externally, wood shingles add weather resistance, and a corrugated metal roof ensures long-term durability with minimal maintenance.

The foundation reflects low-impact engineering principles. Rather than a full concrete slab, the structure is supported on two parallel strip foundations, minimizing the use of cement—one of the highest carbon-emitting materials in construction. The floor system incorporates a triple-layer wooden board, with straw insulation packed between the joists to optimize thermal performance. (Fig. 24, 25)

The building design is fully optimized for energy conservation, employing passive heating and cooling strategies that reduce the need for mechanical climate control. Straw's natural insulating capacity limits heat loss during the winter and prevents overheating during the summer, maintaining stable indoor temperatures throughout the year.

The house also demonstrates a high degree of energy independence. A 5-kilowatt peak solar panel array is installed with a west-east roof orientation to maximize solar gain over the course of the day. Energy is stored in an 18 kWh lead-gel battery, ensuring continuous availability during low-sunlight periods.

Additional systems include a 500-liter thermal buffer tank supported by a 1.5 kW heating element and a high-efficiency wood-burning stove (Pertinger lintel fire oven), which provides heat, cooking capacity, and domestic hot water. Together, these components form an integrated system that requires minimal reliance on external energy sources.

The core innovation in this setup is the use of biogas as a renewable fuel source, enabling fully off-grid operation and closing the loop on waste and energy within a small-scale, resilient household system. (Fig. 26–28)

While biogas technology is commonly applied at an industrial scale, current innovations focus on adapting it for use in individual, off-grid households. Although Germany operates around 9,600 biogas plants, contributing approximately 5.4 % of the national electricity supply, the majority rely on centralized infrastructure and large-scale agricultural inputs. In contrast, small-scale systems demonstrate the feasibility of localized energy production using household-level organic waste streams such as kitchen scraps, animal manure, and plant residues.

The core process relies on anaerobic digestion, wherein microorganisms break down organic matter inside a sealed digester. This reaction produces methane-rich biogas, which is captured in a flexible storage unit, a so-called biogas backpack with a capacity of up to 1,000 liters, sufficient to cover daily cooking and heating needs.

Biogas systems of this scale are well-suited for rural or under-resourced areas. In regions across Africa, Asia, and Latin America, over 100,000 small-scale digesters are already in operation, providing reliable fuel access in locations without formal energy infrastructure.

To maintain optimal functionality, several operating conditions are required:

- Temperature control around 37 °C, simulating the environment of a cow's stomach;
- Hydraulic retention of 35 to 50 days, allowing the full decomposition of organic matter;
- Input quality, with higher methane yields derived from cow manure, food waste, and plant matter.

In this case study, biogas production is further stabilized through the use of solar-heated greenhouses, which help maintain digestion temperatures year-round. The gas undergoes hydrogen sulfide filtration to ensure clean combustion and reduce emissions.

This closed-loop system supports more than just energy autonomy. The digestate byproduct, referred to as bio-slurry, is a potent organic fertilizer, completing the material cycle and contributing to soil regeneration. In this model, all inputs are either converted into renewable energy or reintegrated into the natural ecosystem.

By combining biogas generation with natural building materials, this approach moves beyond basic sustainability to demonstrate a form of regenerative living. The home becomes not only energy-independent but also an active agent in climate mitigation, resource conservation, and ecological resilience.

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Reet © HOPE HOME • НАДІЯ Material Show, Kyiv 2025, Natalia Azarkina

Reed

Reed, or Common Reed (Phragmites australis), is a perennial grass that grows up to 4 meters tall, typically found along riverbanks, in wetlands, and in marshes.

Reet refers to the harvested, dried, and bundled reed used as a building material — especially for thatched roofs. It is characterized by thick, sturdy stems and high durability, making it ideal for traditional craftsmanship such as reed roofing.

It is estimated that up to 40 percent of greenhouse gas emissions, and thus significant climate damage, could result from the reconstruction of Ukraine if conventional building materials such as concrete and plastic continue to be used.

Together with hemp, straw, clay, sheep's wool, and fungi, reed represents one of the most promising CO_2-neutral alternatives, primarily for roofing applications.

Advantages:

- Regionally available, especially in the wetlands of Ukraine
- Renewable and fully biodegradable
- Proven in centuries-old building traditions, particularly for roofs
- Resource-efficient, requiring minimal energy for processing.

Fig. 1: Dry stone walling, early Christian church in Ireland © Gallarus Oratory, Heritage Ireland National Monuments Service

Fig. 2: Palmengarten Frankfurt, Victorian Palm House © Palmengarten Archive, City of Frankfurt am Main

Fig. 3, 4: German School, Madrid © gruentuchernst, Photo: Celia de Coca

Fig. 5, 6: Roman underfloor heating © gruentuchernst (Roman Open-Air Museum Hechingen-Stein)

Fig. 8: Thatched Haubarg barn from 1707 Eiderstedt © wikicommons J.Kullmann, www.meerart.de

Thatched roofs, and increasingly, reed wall panels, have a long tradition in rural areas, including in Ukraine. Today, however, they exist in a field of tension between:

- cultural heritage and modernization pressure
- low-cost reconstruction and ecological sustainability
- traditional craftsmanship and industrial building standards.

Almut Grüntuch-Ernst

Founded the joint architectural practice with Armand Grüntuch in Berlin in 1991. She studied at the University of Stuttgart and at the Architectural Association School of Architecture in London, worked at Alsop & Lyall in London, and taught at the University of the Arts (HdK) in Berlin. Since 2011, she has been Professor and Director of the Institute for Design and Architectural Strategies (IDAS) at TU Braunschweig.

The transformation of a former prison building into the Hotel Wilmina was awarded the German Sustainability Award in 2022. At IDAS, in cooperation with the Institute for Building Climatology and Energy of Architecture, her research focuses on the holistic potential of natural materials in architecture.

These questions will strongly influence our future:

What will we build our future from?
At the beginning of building history stands the fundamental idea that construction materials must be sourced and processed directly from the immediate landscape in order to create spaces. Today, innovations in processing and material technologies open up new possibilities for design and expand the architectural vocabulary. Both aspects must be brought together. Climate change reminds us that everything we design must be done with global responsibility and in harmony with the environment. (Fig. 1, 2)

Building today is no longer aligned with sustainable principles, because:

- energy and transportation costs are extremely high
- the variety of available building materials is vast and confusing, and some contain substances that are harmful to human health
- demolition and the disposal of hazardous waste present major challenges.

How can we make knowledge the benchmark of our actions?
Example: German School, Madrid. (Fig. 3–6)

Approach:

- Combination of high-tech architecture with traditional wisdoms of building culture
- Integration of a natural low-tech ventilation system based on the principle of the hypocaust used in ancient Rome.

For this purpose, a thermal labyrinth was constructed beneath the building, creating a temperature difference of 6 °C.

This allows the underground air currents to be naturally pre-tempered before being directed into the classrooms for ventilation.

Building from nature, within nature
Reed as a building material?
To strategically address the question of materials, it is essential to research and explore the potential of reed in its formal, technical, and ecological dimensions.

Focus: Peatland Areas, Schleswig-Holstein
The history of peatlands is closely linked to the history of the climate. For decades, peatlands were drained to expand agricultural land.

It is now scientifically proven that this drainage released vast amounts of greenhouse gases.

Environmental organizations around the world have long criticized this practice — and by now, their advocacy has led to the rewetting of peatlands becoming a key item on the political agenda, as they can effectively bind CO_2. (Abb. 7)

Renewal of the Peatlands: Back to a Landscape that Builds
The drainage of peatlands in the 1960s radically transformed the landscape of Schleswig-Holstein and endangered a unique ecosystem. The traditional building material reed was also affected: as the wetland areas shrank, reed stocks declined. To protect these reed populations, environmentalists have long called for legal protection — otherwise, complete disappearance would be imminent.

Today, the demand for reed in Germany is increasingly met through imports — 80–90 percent now come from Ukraine, Hungary, Romania, Turkey, and China. This has brought

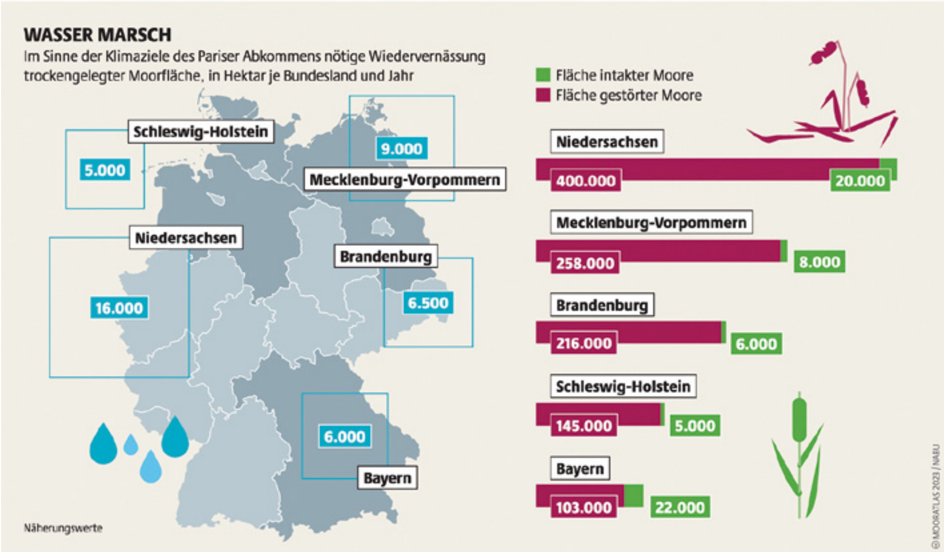

Fig. 7: © Mooratlas 2023, p. 35, https://www.bund.net/fileadmin/user_upload_bund/publikationen/naturschutz/Mooratlas_2023.pdf

Fig. 9: Practical experience © Reet Reloaded

new challenges, such as the introduction of fungi and microorganisms from other climate zones, which complicate the maintenance and durability of thatched roofs.

The rewetting of peatlands also offers great potential for agricultural productivity through the use of paludiculture, the sustainable cultivation of wet peatlands for biomass production while simultaneously preserving the ecosystem.

In Schleswig-Holstein, a valuable architectural heritage can still be found in the form of historic thatched houses, whose craftsmanship and architectural character are deeply rooted in the region's building culture. (Fig. 8)

Worldwide Research on Reed as a Building Material
Across the globe, various research projects are currently exploring how reed can be used as a sustainable construction material.

The Two Key Potentials of Reed

- When used locally, transportation and energy costs are significantly reduced.
- From a human toxicology standpoint, reed is completely harmless, it emits no chemical vapors and therefore poses no health risks.

»The soft roof ... is rainproof, snow proof, frost-resistant, vapor-permeable, breathable, air-filtering, dust-tight, and regulates indoor humidity without condensation due to water vapor diffusion.« — Walter Schattke, master thatcher and author of Das Reetdach: Natürliches Wohnen unter sanftem Dach – von der Urzeit bis heute. ISBN 3-7672-1140-8

Reed as a Monolithic Building Envelope
A monolithic roof covering is one that is made entirely from a single material — in the case of a reed roof, exclusively from reed, without additional membranes, insulation, or sub-roof layers. Reed itself fulfils all essential functions: weather protection, moisture regulation, and diffusion. A monolithic reed roof with a thickness of 35 cm provides sufficient thermal insulation in Northern Germany.

Rethinking Reed: More Than a Roof Covering
In the Reallabor, reed is being explored not only as a roofing material but also as a versatile natural product for insulation, acoustic enhancement, and wall cladding.

Reed Reloaded
Since 2021, the REET RELOADED symposia have been held regularly, promoting exchange of reed as a building material and its ecological as well as formal potential. Experts from various disciplines present their research, share traditional craftsmanship knowledge, and teach professionals and students how to work with reed. Each summer, groups from educational academies gather there to experience this material in practice.

Research Site: Island of Sylt – Klappholttal
Since 1908, numerous small houses have been integrated harmoniously into this 7.5-hectare dune landscape. The small settlement, originally built from natural materials such as wood and reed, consists of sleeping cottages and communal buildings.

Within the institute's educational programs, students develop design concepts for this site under the theme »Building in the landscape – from the landscape.« (Fig. 9)

Practical Experience and Craftsmanship
During a summer school, students realize a collective design project in which the material becomes literally tangible: they process the harvested reed and build a small pavilion from it.

Reed can be harvested once every twelve months. It is not cut, but knocked into shape to achieve the required precise contours. The stems are aligned using a special board to create the exact structure typical of thatched roofs, a technique distinguished by its precision and craftsmanship.

Building as Performative Practice: Living, Building, Learning
In workshops, reed is not only used as a building material but also experienced — in direct connection with the process, the dwelling, and the place. Architecture is understood as a performative act: living and building merge.

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Fig. 10, 11: © Simon Scharnweber

Fig. 12: © Elena Laubeck, © Laura Lisowsky

Fig. 13: © Mira Himmelrath, © Danijela Brlozanovic

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Fig. 14: Cabanon built by the French architect Le Corbusier © https://de.wikipedia.org/wiki/Le_Cabanon

In real-world laboratories, experiments are carried out with various natural materials — reed, seagrass, wool, clay, hemp — all locally available and rich in unexpected properties. Seagrass, for instance, is resistant to insects due to its salt content, opening up entirely new possibilities for use in insulation. To enhance the small existing houses both aesthetically and ecologically, students develop design concepts for »Building in the landscape – from the landscape.«

How can we build on tradition and still design comfortable micro-houses? We are rethinking Le Corbusier:

«I have a château on the Côte d'Azur, 3.66 m by 3.66 m in size. For my wife, it is an abundance of comfort and coziness.« (Fig. 14)

If we maintain the footprint of the existing volume, how can we create a new kind of enclosure using natural building materials — ideally ones that are compostable?

The goal is to use the building envelope made of vegetal materials such as reed — a material with a long-standing tradition. Where do the formal limits and possibilities of this material lie?

The students responded through models: Fig. 10–13.

If we aim to remain minimally invasive, preserving the primary structure and overall volume, and only replace the building envelope in order to create a new climatic interface between the inhabitants and the exterior environment: what changes as a result?

Model study for a new façade that can expand and contract with the climate, allowing the sleeping space to extend multifunctionally into the dune landscape or condense into a small protective shelter.

Implementation begins with the replacement of the building envelope: students fill the walls with seagrass for insulation and construct the weatherproof outer shell from wooden shingles.

Elisabeth Endres – BUILDING FOR TOMORROW – The Opportunity of Challenge

Professor and Director at the Faculty of Architecture, TU Braunschweig, Institute for Building Climatology and Energy, Project Director at the engineering office Hausladen.

Technical Systems for the Performance of Architecture

- Approach of the Hausladen Engineering Office
- The starting point is not the belief that technology alone makes buildings efficient and sustainable. Instead, we focus on the interaction between architecture, building physics, and building climatology — from the very beginning, and in a holistic way.
- Together with architects, we ask at an early design stage: What do we want to achieve with this building?
- We question the necessity of complex building systems: not high-tech, but low-tech — though that does not mean no-tech.
- Buildings should not function solely through technical control, but should interact with the behavior of their users.
- Energy savings and comfort should not be generated by technology alone, but through conscious use, for example, by people simply opening a window themselves.
- The goal is to create robust, durable, repairable, adaptable, and sustainable buildings that function with minimal technology, and precisely because of that, remain truly high-performing. (Fig. 15)

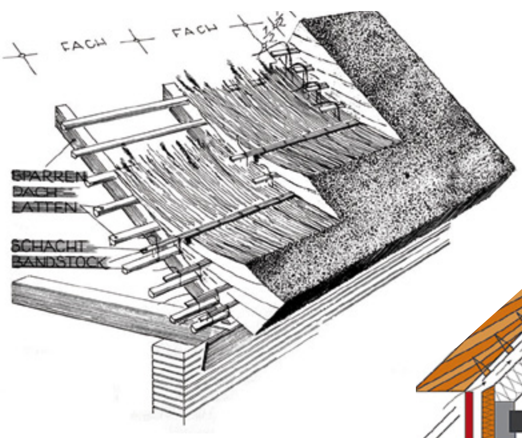
Challenge

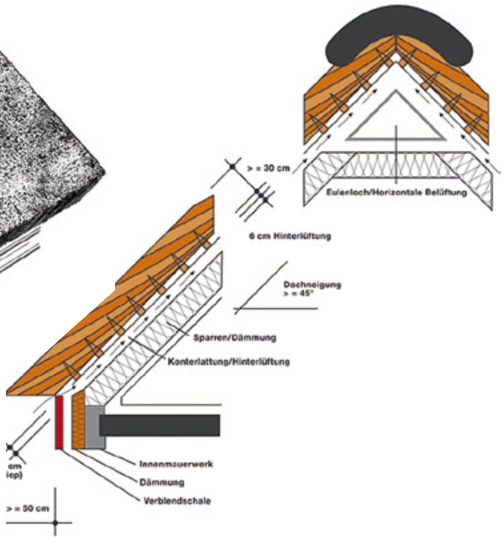
We need to develop an attitude toward how we deal with the seemingly limitless possibilities of technology in the 21st century — moving away from designing for a maximum optimum, which, in practice, can collapse dramatically when even small deviations in user behavior occur, for instance, when someone simply opens a window manually.

We need new standards, new materialities, and new solar geometries, we need a robust optimum. Buildings that continue to perform well even when patterns of use change, when more or fewer people inhabit them, or when maintenance cycles cannot be perfectly maintained.

Impact	Figure / Share	Comment / Possible Solutions
CO_2 emissions during construction and operation	40 %	Energy savings, alternative building materials, climate-friendly construction methods
Waste generation in the construction industry	52 %	Promote recycling, reduce hazardous waste, establish circular economy principles
Consumption of mineral, non-renewable raw materials	90 %	Stop resource depletion, promote urban mining, reuse materials, close material cycles

Fig. 15: Source: UNEP, Building Materials and Climate, 2022; ScienceDirect, Construction and Demolition Waste, 2023; TBI Contracting, Hidden Cost of Non-Renewable Resources, 2023





Figs. 16, 17: Construction drawings © Elisabeth Endres

Fig. 18: Learning from the thatched-roof building tradition, Keitum Sylt Museum

Fig. 19, 20: Multifunctional, multi-layered solution: Thatched roof plastered with clay on the inside © Elisabeth Endres

Robust architecture addresses the question of expectations, and asks what architecture itself can contribute, inherently, without relying entirely on technical systems.

Example: The general insulation standard has been optimized to such a degree that minimal heat loss through walls is now assumed. Transmission heat loss (through façades) has been minimized, yet this optimization can make systems more fragile.

We must therefore continue to design buildings with long life cycles, focusing on the key problem areas of both construction and operation. **Learning from reed-based building culture – Example: Keitum, Sylt Museum.** (Fig. 18)

Traditional Construction Applied with Wisdom.
Traditional building methods were intelligently conceived, taking into account both the prevailing wind direction and the risk of fire.

- Prevailing wind from the west: the stable for animals was placed on the western side, serving as a windbreak to minimize the impact of strong winds.
- Entrance design: the entrance was positioned so that, in case of fire, the thatch would not fall directly over the doorway but to the side — fire protection through design.

Despite all progress and technological advancement, such simple principles are often forgotten in contemporary planning — demonstrating how architecture and function can be achieved through straightforward, thoughtful design. (Fig. 19, 20)

The Reed Roof – A Multifunctional Building Envelope with a Long Tradition

The reed roof has a long history as a multifunctional building envelope: it protects against rain, wind, and cold, while storing heat and allowing the building to breathe.

Today, however, it is often reduced to its water-shedding function — decorative, but no longer truly effective.

We aim to return to a layered, multifunctional roof structure:

- the reed layer is ventilated and thus thermally decoupled
- insulation is placed between the rafters
- interior clay plaster provides thermal mass and moisture regulation
- integrated heating coils within the clay layer enable radiant heat — a modern, nature-based solution.

Igor Kleban

Reed Harvester and Producer. Harvesting, processing, and exporting reed to the EU, as well as producing reed panels. Founder of the company Reedkli, based in Stryj, Lviv region, Ukraine.

History and Significance of Reed
Antiquity: Even in early civilizations, reed was used in many ways — especially as a roofing and ceiling material. It was inexpensive, locally available, and provided excellent thermal insulation. Thus, reed symbolized a building culture that made careful use of the resources at hand.

Present: With the revival of ecological construction, reed is experiencing a renaissance today. It is used not only in the careful restoration of historic buildings but increasingly in modern eco-houses. It stands for sustainability, regional value creation, and a return to natural building materials.

Milestones

- In 2013, Igor Kleban began learning about reed — harvesting it and exporting it abroad, initially in small quantities to Poland, and later in larger volumes to other EU countries. The island of Sylt holds a special place in this development.
- In 2017, he established a network in Ukraine — researching who was working with this biomaterial, in which regions it grows best, and how it can be used.
- In the same year, he founded the company Reedkli.
- He personally monitors the quality, hardness, moisture content, and length of the exported reed.
- He provides consultations, courses, and workshops on reed harvesting techniques.
- He also helps others to gain a foothold in the reed business.

This hotel is the largest project Igor Kleban has ever managed as an importer of reed from Ukraine. Many companies he collaborates with source their reed for Sylt from Ukraine, as it is known for being particularly hard, dense, and uniform in quality. (Abb. 21)

He carries out the harvesting together with partners from Denmark, Germany, and Poland. However, the ongoing war deeply worries him — he fears losing competitiveness, as countries not affected by conflict, such as China and

Fig. 21: Europe's largest thatched roof, Lanserhof on Sylt

Fig. 22: Open-air museum in Lviv, stepped thatch covering, 40–60 cm thick reed walls

Fig. 23: Reed panels, decorative and (sound) insulating

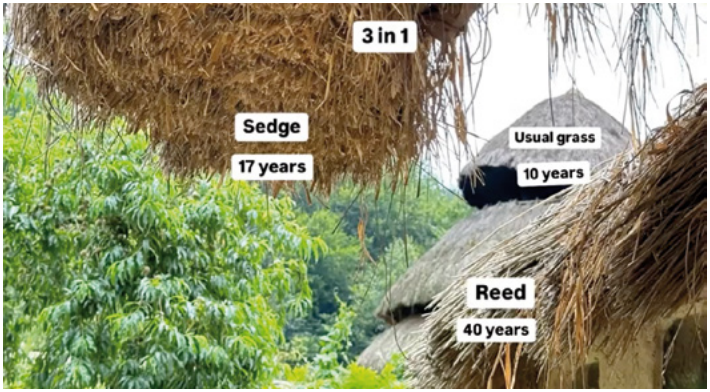


Fig. 26, 27: House made from local natural materials and overview of the materials used and their respective durability © Mark Melnychenko

Fig. 24: Natural reed board, ecological and heat insulating

Fig. 25: Flexible reed board, strong, malleable, versatile

Kazakhstan, continue to expand their markets. Already today, 60 percent of all reed used in Europe comes from China.

Another concern is that his most important contracts involve the renovation of thatched roofs, which require large quantities of high-quality reed. Currently, harvesting takes place in southern Ukraine, but the peatlands there have dried out, making it impossible to reliably predict the quality and quantity of the available reed, which complicates both planning and delivery.

Projects and products:

- At the Open-Air Museum in Lviv, he applied the traditional stepped thatching technique, in which reed is laid in overlapping layers from bottom to top to protect the roof effectively against weather and ensure durability.
- He built walls from tightly bound reed bundles, 40–60 cm thick – a construction method that provides excellent thermal and acoustic insulation and demonstrates the versatile use of reed in traditional architecture.
- Reed panels, made from densely compressed reed, are increasingly in demand for their natural aesthetic and for their sound- and heat-insulating properties.
- Decorative applications, for example lampshades, which create a warm, atmospheric light through the natural texture of the material. (Fig. 22–25)

Mark Melnychenko – A Natural House Full of Stories

Ecoactivist and blogger with over one hundred thousand followers on Instagram (@my_ukrainian_dream), Mark Melnychenko has been building exclusively with local natural materials for more than eleven years.

In 2021, he invited his online community to join him in repairing a natural house. Ten volunteers aged between sixteen and forty answered his call, spending a summer between the forests of the Carpathians and the construction site — learning how to thatch a roof and, above all, how to work with their hands and with nature. By the end of summer, the roof of his house stood completed in true DIY spirit: sealed, circular, covered with reed — a tangible result of collective work.

Melnychenko presents two houses: his father's four-story home and his own, still unfinished, lacking the third floor and plaster. Every repair and construction step is an experiment.

In Transcarpathia, in western Ukraine, it is traditional to use rye straw for roofing because reed is rare. Yet Melnychenko prefers reed, laying it in circular patterns as was once common in England and Germany, tying the stems with natural fiber ropes — a technique that transforms simple materials into enduring works of craft.

He is unafraid of experimentation: a roof made from grass normally used as animal feed lasted ten years in the Carpathians, storing moisture like a sponge. Sedge, a riverbank plant, protected another roof for seventeen years. Reed, however, can last up to forty years — if the material, roof pitch, and craftsmanship are right, and if gravity allows water to run off naturally.

After all these experiments, one conclusion is clear: hay, straw, and reed are not merely building materials, they are materials of the future, telling stories and giving life to houses.

Melnychenko's vision is clear: to build homes rooted in their surroundings, respectful of nature, and based on local resources. Here, low-tech meets high-tech: on the southern side of his house, a solar system collects energy, while the walls are built from materials gathered from nearby meadows and fields.

These are the challenges he faces:

- Water supply, in the mountains, a well must be drilled up to 100 meters deep
- Rapidly changing temperatures can cause reed stems to bend in the wrong direction; during repairs, it becomes evident how essential it is to use material from the same region, otherwise small gaps appear in the roof
- Before the war, one square meter of thatched roof cost around 40 euros; now it is 55–60 euros, while in Germany it costs 130–160 euros/m²
- Reed fields in Ukraine – many are inaccessible: occupied, mined, or destroyed.

Sheep's wool © Folke Koebberling RECOMMENDED FOR IMITATION! Berlin 2023 © Andreas Rost

Sheep Wool

Facts and Figures

- Sheep's wool is considered one of the oldest renewable raw materials processed by humans.
- Around 6000 BC: first wool processing in Mesopotamia.
- Clothing has been made from wool for 8,000 to 10,000 years.
- The sheep population in Germany has declined from 2.7 million in 2000 to 1.5 million in 2024. Most sheep worldwide are found in China, Australia, New Zealand, India, and Africa. Ukraine has around 800,000 sheep.
- The pandemic severely reduced the demand for sheep wool, including valuable white wool.
- A single shearing yields four to five kilograms of wool. In Germany, shearing costs per animal are about three to four euros.
- The market price for wool fluctuates between 10 and 40 cents per kilogram.
- Although wool is an agricultural product, it is taxed at 19% in Germany.
- According to German animal welfare laws, wool must be disposed of as special waste (Category 3: Animal by-products), which incurs a fee.
- Wool accounts for only about 3% of global fiber production, which equals approximately 32 million tons per year.
- Across Europe, raw wool remains unsold in storage due to the lack of processing facilities.

Fig. 1: Sheep with a one-year-old coat, and sheep sheared © Folke Köbberling

Fig. 3, 4: Wool factory in Biella, Italy. Wool is still being sorted, but not processed further, as there are no longer any wool washing lines in the entire country. © Folke Köbberling, Wollbau, pp. 50-51

Fig. 2: Australian sheep, 5 years unshorn © Reuters/ RSPCA

Fig. 5: Scotland, sheep's wool is soaked in spirits to make it flammable © Farmers Guardian July 2, 2020

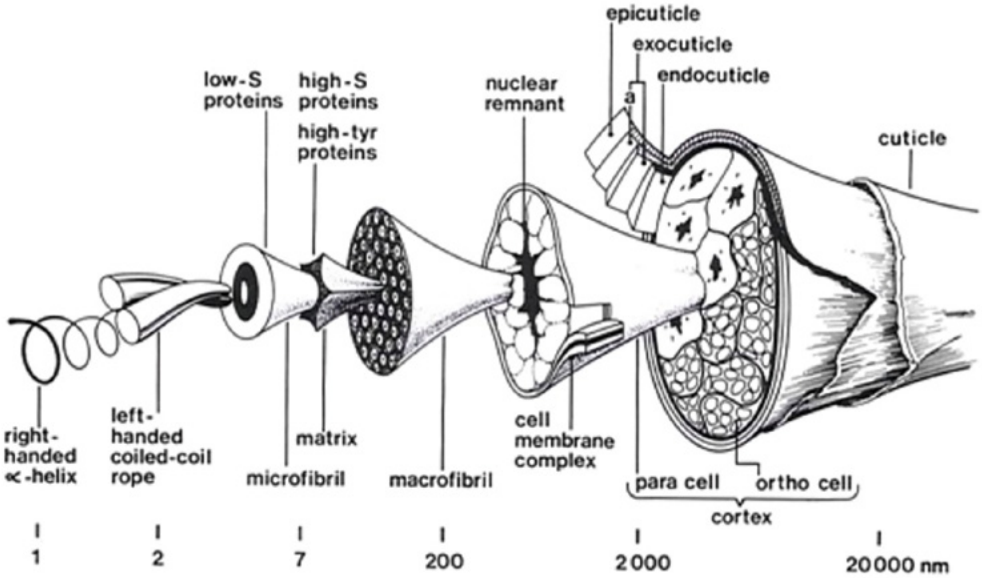


Fig. 6: Wool fiber and its properties: acoustics, reinforcement, insulation, protection, pollutants, fertilizer. © FK, Wool Construction, pp. 52–53

Therefore, sheep in Germany, and across most of Europe, are primarily used for landscape maintenance and erosion control, in addition to meat consumption. Wool, as a by-product, no longer represents a significant source of income for shepherds, since textile production and wool washing facilities have largely been shut down. (Fig. 3, 4)

Stattdessen rückt allmählich die Wahrnehmung von Instead, wool is gradually coming to be recognized as a renewable and versatile building material.

- Naturally occurring raw material, 100% recyclable and reusable
- Can equally help heal skin, air, soil, and buildings
- Has flame-retardant properties due to its high nitrogen content, classified as EURO Class E
- Ignites only at 580–600°C; by comparison, steel begins to deform at 500–550°C (Fig. 5)
- Can absorb up to 100 times its own weight in oil and tar and can be reused multiple times for this purpose. The absorbed oil can be re-refined.
- Can act as a fertilizer by absorbing and breaking down contaminants like hydrochloric acid and mercury from the soil without becoming contaminated itself.
- Has versatile applications: for insulating roofs, exterior/interior walls, basements, as flooring, as a filter material, and as a base layer for green roofs.
- Can be used sustainably — reused, recycled, or repurposed with minimal resource input.
- Can be used on-site in its raw form without additional energy.
- Regulates humidity and indoor climate, and offers protection from moisture damage.
- Is a complex, high-performance fiber composed of three layers. Thanks to the wool fat lanolin, it is both water-repellent and water-absorbent, capable of taking in up to 30% of its weight in moisture.
- Retains its insulating properties even when wet, is extremely elastic, and can be bent thousands of times without tearing. (Fig. 6)

Folke Köbberling – Numerous Experiments Lead to Major Insights Into Sheep Wool

Folke Köbberling studied Fine Arts and works as a freelance artist. Through site-specific sculptural installations in public space, she explores themes of self-organization, traffic, mobility, resource scarcity, and sustainability. Since 2016, she has been Professor of Artistic Design at the Institute for Art in Architecture (IAK) at TU Braunschweig. Since 2018, Köbberling has been engaged with raw sheep wool, a material that insulates, filters acoustically, carries scent, contains lanolin, heals, warms, and isolates, aiming to explore new possibilities for its use through both scientific and artistic approaches. She traveled for 13 years as an artist with EXAMPLES TO FOLLOW! and is part of the core team of Hope Home • НАДІЯ.

Series of experiments / qualities / capacities / sculptures – EXAMPLES TO FOLLOW!

Wool as a Protective/Insulating Layer for Roofs
Wool was laid directly on a fleece base on a roof for several winter months, undisturbed. During this period, precipitation was recorded. Through the motion of rainfall, the wool fibers interlocked and felted into a water-resistant layer or blanket that temporarily insulated and protected the roof. For this to be effective, however, the roof must have a pitch of at least 45 degrees. The outer layer of the fiber, the cuticle, is water-repellent and functions similarly to a roof covering. Inside the cuticle are air pockets that provide natural insulation.

Over time, through exposure to wind, weather, and nature, wool develops a natural patina — a biofilm that settles on the surface without compromising its insulating properties

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Fig. 11: 200 modular Wall boxes, 60 x 30 x each 30 cm © Andreas Bormann, FK, Wollbau, pp. 64–65

Fig. 12: 200 modular Wall boxes, 60 x 30 x each 30 cm © Andreas Bormann, FK, Wollbau, pp. 64–65

Fig. 7: Detail of raw wool with weather-altered surface © FK Wollbau, p. 134 | Fig. 8: Structure of raw wool as a trellis © FK Wollbau, p. 135

Fig. 9: Demonstration 1: Dewool © Bernd Schulz
Fig. 10: Demonstration 2: Wool curtain © FK, Wollbau, p. 57

Fig. 14: Load-bearing capacity of wool-clay-jute mixtures © Leon Zimmermann / Institute for Architecture-Related Art, TU Braunschweig

Fig. 13: Wolf in sheep's clothing Club Hybrid, Graz 2021–23 © Wolfgang Thaler, FK, Wollbau, pp. 140–41

underneath. Even when wet, wool remains effective as an insulating material. Unlike many synthetic materials, it does not mold and retains its functionality. This makes it an ecologically valuable material with great potential for sustainable applications. (Fig. 7, 8)

For acoustic and thermal insulation

- Demonstration 1 • 1.5 tons of raw wool from local sheep are exhibited in a gallery space, allowing visitors to physically experience its full insulating properties. Dimensions: 4 x 4 x 3 meters
- Demonstration 2 • A long-term observation of a wool curtain installed at the Institute for Art in Architecture (IAK), made from a total of 300 kg of wool, serves to demonstrate and validate this hypothesis. (Fig. 9, 10)

Observation:
The best sound absorption is achieved using coarse wool in a densely packed state. Insights and measurements from this were transferred into a modular system: an acoustic wall filled with raw wool and a Duplo-style box system were developed for this purpose.

However, after two years, moth damage destroyed the wool structure. Wool is composed of 97% keratin, a fibrous protein that attracts moths.

They can, however, be kept away relatively easily using materials such as cellulose, jute, or a clay layer. Moths are sensitive to heat and cold: at temperatures above 60°C, the protein coagulates and moth eggs and larvae die off; they also die at temperatures below -18°C. (Fig. 11, 12)

As protection for a wooden façade
A wall measuring 40 meters in length and 10 meters in height was covered with raw wool for this purpose. After two years, there was slight fading on the sun-facing side — but no moth damage whatsoever! Evidently, the seasonal shifts between heat and cold also deter moths. The underlying wooden structure remained nearly as good as new, in contrast to an untreated area on the opposite side, which showed significant weathering under the same conditions. Over time, the wool developed a layer of algae that offered additional protection and preserved its insulating properties beneath the natural patina. After dismantling the wool wall, the material was repurposed as fertilizer and as an additive for clay. (Abb. 13)

As a Natural Reinforcement Material
Elastic sheep wool can be used as a natural fiber reinforcement in various materials—especially in clay or earthen construction. Similar to straw, it improves crack resistance and structural stability, while replacing environmentally harmful synthetic fibers like glass or carbon fibers. These synthetic materials are energy-intensive to produce, mostly non-recyclable, and hazardous when inhaled.

Wool composites offer high durability and stability
In a student project, various load-bearing tests using wool in combination with clay and jute—or waste materials—demonstrated remarkable strength. A special folding technique enabled the structure to support over 200 kg. The substructure measured 45 cm in height, xx in length, with a wall thickness of just 3 mm. The exceptionally high load-bearing capacity was made possible by the folded design. (Fig. 14)

EXAMPLES TO FOLLOW! – explorations in aesthetics and sustainability, Berlin 2023
A walk-in research sculpture made of modular wool–clay elements. The aim was to create lightweight, dismantlable, and transportable constructions, as clay, while ecologically valuable, is very heavy as a building material. A new frame system was developed, densely packed with wool. One side of the frame was left open and touchable to allow the wool to be compressed if needed, while the other side was covered with wool fleece and then coated in clay. This created a crack-resistant clay protective layer around the wool. Each frame weighed around 30 kg and could easily be assembled, disassembled, or composted at any time.

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Fig. 15: Workshop in the exhibition. EXAMPLES TO FOLLOW! © Folke Köbberling

Fig. 16: Wool House exterior, 11 wooden elements, 650 x 300 x 34 cm, Wool House EXAMPLES TO FOLLOW! 2023 Berlin © Siegfried Dengler, FK, Wool Construction, p. 122 | Fig. 17: Wool House interior view, 11 wooden elements, 650 x 300 x 34 cm, Wool House EXAMPLES TO FOLLOW! 2023 Berlin © Siegfried Dengler, FK, Wool Construction, p. 123

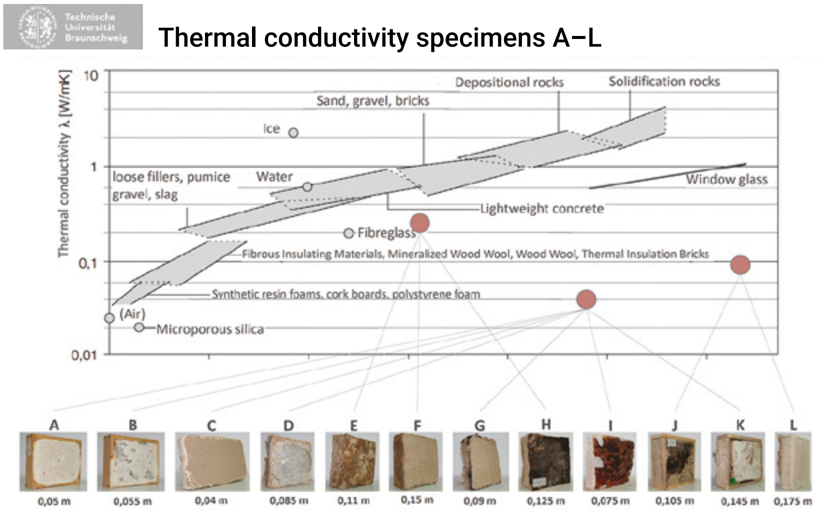

Fig. 18, 19: Samples for measuring how well a material conducts heat, ZNE! Berlin 2023 and TU Braunschweig © IBEA, Tobias Pörschke

During the exhibition, Natalija Miodragović, also an expert from HOPE HOME • НАДІЯ and Matters of Activity, began a one-week workshop exploring the combination of wool and mycelium to develop new architectural forms.

These investigations have been scientifically evaluated and have since provided valuable insights into the use of wool in the fields of acoustics, reinforcement, insulation, protection, pollutant filtration, and as fertilizer. (Fig. 15–17)

Tobias Pörschke – Scientific Evaluations of The Materials

Tobias Pörschke – Research Associate at TU Braunschweig, Institute for Building Climatology and Energy of Architecture.

His scientific focus lies in material analysis aimed at reducing the reliance on technical systems and improving indoor comfort.

As part of the exhibition EXAMPLES TO FOLLOW!, the institute conducted extensive research on natural building materials used as composites, particularly examining their potential to naturally regulate indoor climates and minimize the need for active technology.

Fifteen different combinations of clay, wood, sheep wool, hemp, willow, and fungi were tested. Sensors placed at varying depths allowed for detailed analysis of the moisture and thermal buffering capacities of these materials.

One of the most promising results came from a combination of clay-based construction materials with underlying sheep wool insulation. This solution eliminated the need for a vapor barrier, as the natural materials themselves ensured balanced moisture regulation. (Fig. 18)

In addition to technical performance, the aesthetics of natural building materials were also examined. Tests showed that these materials are in no way inferior to conventional construction materials and can be processed in such a way that there is no visible difference. Particularly noteworthy is the combination of natural materials with conventional support structures: for example, metal stud walls with gypsum boards and mineral wool can be replaced by ecological alternatives such as sheep wool and wood fiber insulation panels.

All materials explored during the workshops and discussed in this book exhibit high water absorption capacity, a clear advantage in high-temperature conditions. Lower supply temperatures in radiant heating systems could reduce the peak load on heat pumps, enabling more efficient use of renewable energy.

Another research focus is the combination of sheep wool with mycelium as a binding agent. Initial tests indicate that these material blends offer promising thermal conductivity values comparable to conventional insulation materials. Especially effective is the combination with bark, which achieved the best insulation performance.

Simultaneously, the potential of natural materials as sustainable alternatives to mineral-based insulation was assessed. Replacing conventional materials with sheep wool could reduce greenhouse gas potential by approximately 13 %.

An innovative approach involves the use of a fungal matrix that both stabilizes the wool and protects it from insect infestation. (Fig. 19)

Volodymyr Klymenko – Kyiv, Ukraine

Director of the company Eco Generals, which continues a long tradition of sheep (and cattle) breeding — a field with great potential thanks to the animal's versatile uses — but, like most livestock operations in Ukraine, has been in a troubling state since the beginning of Russia's war of aggression.

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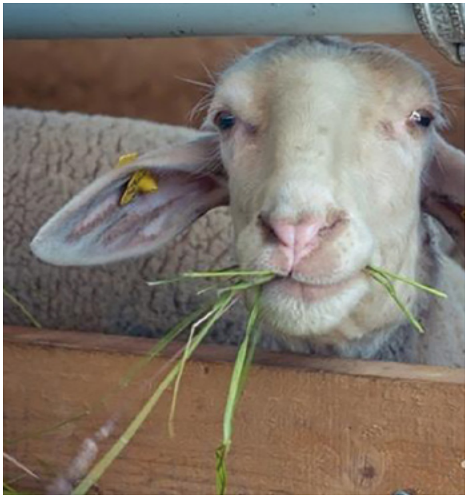

Fig. 20–22: Farm in Ukraine © Volodymyr Klymenko

The Importance of Sheep Wool for the Ukrainian Economy
Wool production once played a significant role in Ukraine's economy, particularly in exports. In the 1990s, up to 60 percent of wool products were exported to Europe. Two major factories in Kharkiv and Dnipropetrovsk supplied around 68 percent of the country's total raw wool output. Today, these facilities are closed, and large stockpiles of unused wool remain, as neither processing nor export is currently possible. As in much of Europe, this has led to a wool surplus. For this reason, alternative uses—such as acoustic and thermal insulation materials—should be expanded as quickly as possible. (Fig. 20–22)

Challenges of sheep farming in Ukraine
Ukraine once had extensive expertise in processing this natural resource, known especially for its excellent insulating properties. However, only about 10 percent of the sheep population from the 1990s remains across the country today. After the occupation of Crimea, there was little government support to sustain sheep farming. As a result, many farms were forced to shut down, and the animals were slaughtered.

This decline is particularly tragic given that sheep wool is a highly exportable product and that shepherds represent an important part of Ukraine's cultural heritage.

Previously, the wool was delivered to a factory in Kharkiv that specialized in textile production, but the facility was shut down after the full-scale war began.

Here is a glimmer of hope in the growing demand for lamb meat within Ukraine. The Romanov sheep breed, in particular, has proven to be robust and well-adapted to the Ukrainian climate. Government support would be crucial in this area, but at present, funding is directed almost entirely toward the military sector. As a result, many farmers are facing severe existential challenges.

Given the enormous potential of new applications for wool, this sector could be easily and successfully revitalized. Sustainable reconstruction using wool and clay could offer both an ecological and economic opportunity — for Ukraine and for other European countries alike.

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Zaur Alyiv – Mykolaiv, Ukraine

Local sheep farming in the Mykolaiv region of Ukraine is facing a growing — and very tangible — challenge: large quantities of sheep wool can no longer be sold or processed. Since sheep shearing is essential for animal welfare and cannot be skipped, large piles of raw wool are now accumulating on-site. The total volume has reportedly reached up to ten tons. Currently, there are no viable options for utilization, export, or proper disposal.

Traditionally, sheep wool was used for making blankets and other textiles. A less common but promising alternative is its use as fertilizer in agriculture. Rich in nutrients, wool can improve soil quality and, for example, enhance tomato growth by gradually releasing nitrogen.

There is also increasing interest in the use of sheep wool in sustainable construction, particularly as a natural insulation material. When combined with other organic components, it could serve as the basis for modular building elements — offering an environmentally friendly alternative to conventional materials that will be in high demand during Ukraine's reconstruction.

Natalija Miodragovic – Sheep Wool and Willow

Another locally renewable building material is fast-growing willow, which can be combined with sheep wool as a woven structure. The branches provide a stable framework, while the wool serves as insulation. A thin layer of clay can be applied as an additional protective coating. This construction method allows for both simple and complex forms and holds great potential for flexible, sustainable architecture. It presents an ecological and economical alternative to conventional building industries. (Fig. 23–26)

Fig. 23–26: Structures made from willow branches, EXAMPLES TO FOLLOW! 2023 Berlin, Natalija Miodragovic © Andrija Mihailović

Fig. 27: Ignition temperatures of various materials
© Andreas Flock | Fig. 28: Wool is more resistant than steel
© Andreas Flock

Andreas Flock – Certified Expert in Fire Protection

Andreas Flock – Civil Engineer and Certified Expert for Preventive Fire Protection, Fire Safety in Existing Buildings, and Fire Safety in Circular Construction, Network HOPE HOME • НАДІЯ.

Resources in the Construction Industry in Times of Peace and War

According to the German Sustainable Building Council, the conventional construction industry consumes half of all materials and generates half of all waste — even in times of peace. This figure underlines the urgent need to develop sustainable alternatives.

Over the entire life cycle of a building, half of the energy is consumed during the construction phase — before the building is even inhabited. This clearly shows how pressing it is to reduce resource use through renewable materials.

Even in peaceful times, the focus must be on preserving what exists, repairing it, and building new only with care. In times of war, there is an even greater need to work with what remains usable. Constant improvisation and ongoing research are required to establish resource-efficient alternatives that can endure under both conditions. Sheep wool can play an outstanding role in this — not only ecologically, but also economically.

Sheep Wool as a Fire Protection Material

In fire protection, many organic materials are viewed critically due to their potential to release toxic gases during a fire. However, plastics far exceed them in both quantity and toxicity of smoke emissions. Like other living materials, sheep wool has the ability to protect itself in the event of a fire, making it a highly effective material for structural fire safety.

- Formation of a heat-insulating carbon layer
- The high sulfur content in the fiber, combined with moisture and nitrogen, slows down oxidation. Two-thirds of the material's structure consists of trapped air, providing additional protection against heat.
- No dripping or open flames: While synthetic insulation materials can melt and produce burning droplets during a fire, sheep wool chars without producing an open flame.

- Low smoke development: The dense structure of wool fibers ensures significantly less smoke is produced during a fire compared to many other organic materials.
- During pyrolysis, sheep wool forms a carbon-rich substance — biochar — which can bind pollutants for soil or water purification.

»Natural building materials don't want to burn!«
»Wool is more fire-resistant than steel!«

A key concept in fire protection is the distinction between combustibility and fire resistance. Sheep wool shows its potential in this regard: despite its organic nature, it can protect load-bearing structures in the event of a fire while also delivering excellent insulation performance. (Fig. 27, 28)

Sheep Wool as a Sustainable Building Material
In addition to its fire protection benefits, sheep wool offers several other key advantages:

- Efficient thermal and sound insulation: Sheep wool naturally regulates temperature and humidity, creating a comfortable indoor climate.
- Durability and ease of use: Unlike synthetic materials, sheep wool remains stable over decades without losing its protective properties.
- Resource-efficient, circular construction: When combined with clay or wood, it enables the creation of stable, energy-efficient buildings that require little to no energy-intensive materials.

Sheep Wool for Soil Detoxification
In addition to its advantages as a building material, sheep wool possesses a frequently underestimated ability: it can cleanse contaminated soils. Thanks to the molecular structure of its amino acids, it can bind and retain pollutants from the soil. These include:

- Heavy metals such as mercury, lead, or cadmium
- Acids and bases, which it can neutralize due to its chemical composition
- Nitrogen compounds, which it naturally contains, making it usable as an organic fertilizer

Especially in war-affected or industrially contaminated regions, sheep wool, combined with plants like hemp, could make a valuable contribution to soil regeneration. This combination could help improve long-term soil quality and make the land suitable for agricultural use.

Future Perspectives and Challenges
Despite the significant advantages of sheep wool in the construction sector, there are still considerable obstacles:

- Lack of standardization and certification: The use of natural materials is often unnecessarily complicated due to strict regulations. A simplified approval process could help overcome this barrier.
- Industrial use and availability: Despite the large quantities of wool available, there is a lack of infrastructure for industrial processing. Stronger collaboration between agriculture and the construction sector is needed.
- Awareness-building: The benefits of sheep wool as a building material and soil purifier are still not widely known. Research and public outreach are essential.

Conclusion: Sheep wool is far more than a traditional material — it addresses key challenges in the construction industry: fire protection, sustainability, and environmental regeneration. It could and should play a key role in the architecture of the future, as it combines safety, ecological responsibility, and resource efficiency.

With targeted research, adapted construction methods, and increased use of circular materials, sheep wool has the potential to revolutionize fire safety and contribute to the purification of soil and water.

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Fomes-fomentarius © Vera Meyer

Fungi

Mycelium, the extensive, thread-like cellular network of fungi, is emerging as one of the most versatile materials of our time. Unlike conventional industrial materials, mycelium is alive, self-growing, and fully biodegradable. It naturally grows on agricultural or forestry waste such as straw, hemp shives, or sawdust, binding plant particles into lightweight, durable composites without the need for synthetic adhesives or harmful chemicals.

Mycelium-based materials can be shock-absorbent, water-repellent, fire-resistant, and insulating — all produced with minimal energy input and safely returned to the environment at the end of their life cycle. In short, mycelium is not just a substitute for resource-intensive materials like plastic or concrete, but represents a radically new paradigm for how we design, build, and reconnect with the natural world.

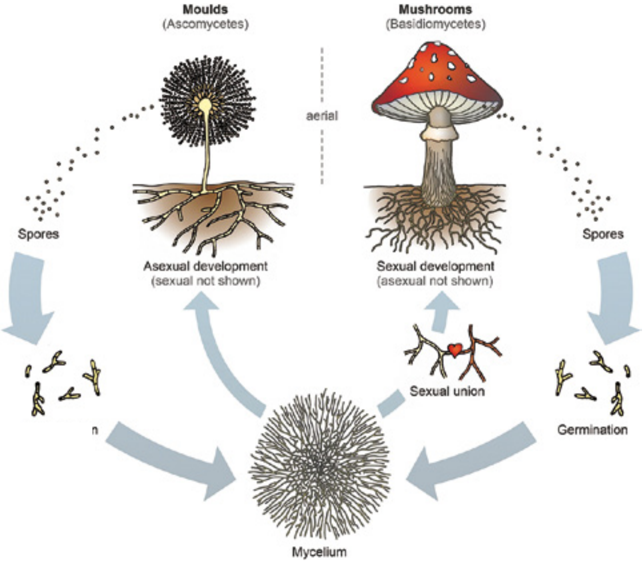

Fig. 1: The world of Fungi © Meyer et al. (2020) FBB 7:5

Abb. 2: *Fomes-fomentarius* © Vera Meyer

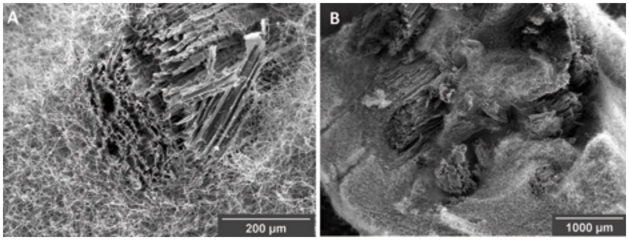

Fig. 3: Isolate mycelium from the fruiting body and grow it on various agricultural and forestry waste materials. © Pohl et al. (2022) Fung Biol Biotechnol 9

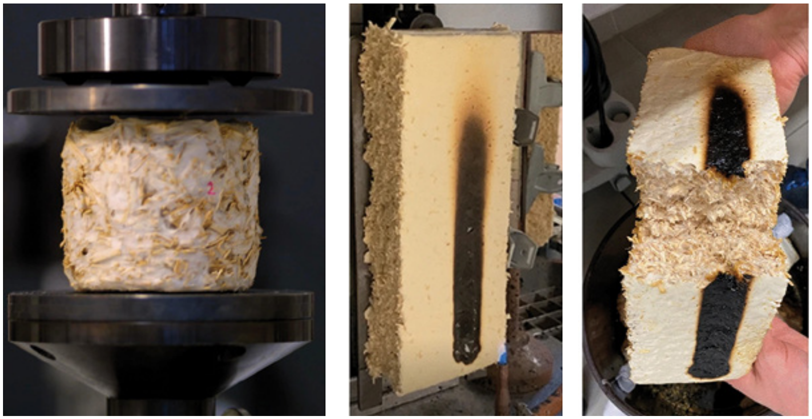

Fig. 7: Fire tests according to EU standards showing that only the outer layer of the mycelium burns, while the inner part remains unaffected. © Pohl et al. (2022) Fungal Biol Biotechnol 9 | Schmidt et al. (2023) Fungal Biol Biotechnol 10

Vera Meyer – Building with Fungi as a Radical Act of Regeneration

As a professor and Doctor of Engineering, she leads the Chair of Applied and Molecular Microbiology at TU Berlin. She works at the intersection of science and art. Her biotechnological research focuses on the use of fungi in industrial applications, particularly in the development of sustainable materials for the construction sector.

What Can Fungi Do?

- We only see the fruiting bodies of fungi above ground with our eyes. The actual fungal network, the mycelium, stretches underground and can cover several hundred square kilometres.
- It is estimated that there are 5.6 million species of fungi on Earth, a number comparable to animal species, but only a small portion, around 130,000, has been studied so far.
- Most fungi are saprophytes, meaning they decompose dead organic matter and play a crucial role as recyclers in nature.
- Only a few species are pathogenic (around 150–400 for humans and approximately 6,000 for plants), and even fewer — just 30 to 40 — are used in biotechnology as cell factories to produce various substances.
- Fungi have long been an integral part of biotechnology. Aspergillus niger gained historical importance during World War I when it became a source of citric acid production after traditional sources (like lemon trees) became inaccessible. This discovery is considered the birth of modern biotechnology and gave a significant boost to the pharmaceutical company Pfizer, which later mass-produced penicillin and, more recently, COVID-19 vaccines.
- With enzymes from Aspergillus niger, we can also wash laundry at lower temperatures — around 20 degrees Celsius.
- Fungal composites could completely replace Styrofoam, which breaks down into microplastics and persists in the environment for centuries.

»Whatever you have touched, eaten, or worn today...«
… probably has something to do with fungal biotechnology, though you may not be aware of it. It influences our daily lives through food and pharmaceuticals, as well as textiles and cleaning agents. The market for fungal biotechnology products is estimated at over 54 trillion USD across sectors such as food, healthcare, environmental management, and materials. (Fig. 1–3)

Fungi can recycle virtually any organic material on Earth. Whatever we offer them as a food source — including agricultural and forestry waste — they are able to convert it into their own biomass and form compounds that can serve as the foundation for entire industries.

We build with fungi! We • must • build • with • fungi!

The Tinder Fungus – Fomes fomentarius

- Properties of the Fruiting Body: Lightweight, water-repellent, shock-absorbing (important for earthquake-prone regions), and durable.
- The fruiting body itself is not used directly. Instead, the mycelium is isolated and cultivated on agricultural and forestry by-products, such as hemp shives or straw. During cultivation, the mycelium binds the plant particles together, forming a composite material that is stable, lightweight, and sustainable.
- This material can be shaped freely as it grows and later pressed into particle boards or flexible panels, depending on the intended application. The full production process takes around six weeks and offers endless design possibilities — including 3D printing.

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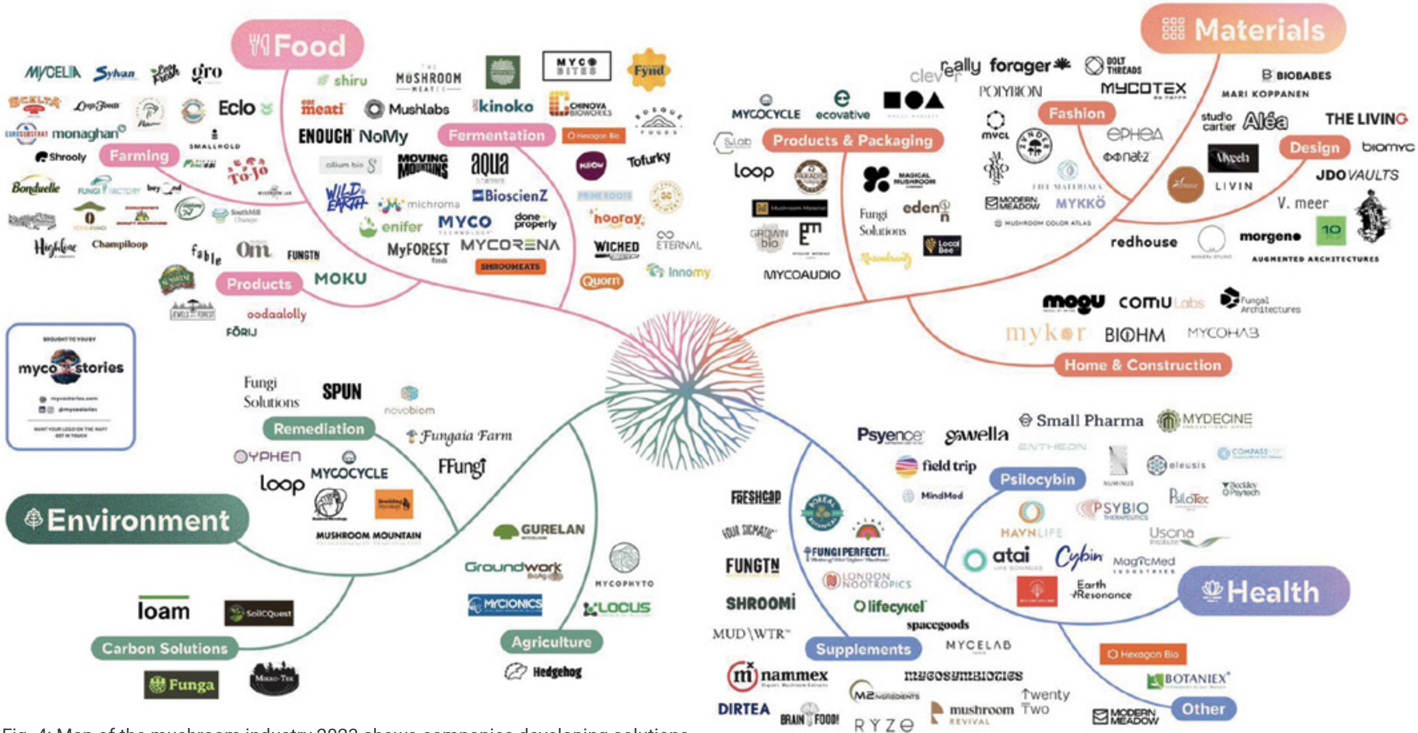

Fig. 4: Map of the mushroom industry 2023 shows companies developing solutions based on fungi and mycelia © Marc Violo, 2023 Mycostories ltd.

The contribution of fungi to the global market is USD 54.59 trillion

Pharma	USD 1.28 trillion
Automotive	USD 2.56 trillion
Chemical	USD 7.68 trillion
Food	USD 8.62 trillion

Fig. 5: Importance of fungal biotechnology for our everyday lives. (The market for biotechnological fungal products is estimated at USD 54.59 trillion. Niego et al. (2023) Fungal Diversity) © Meyer et al. 2020, FBB 7:5

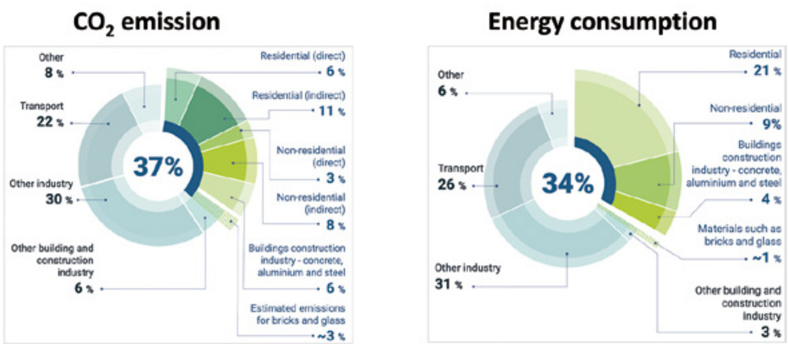

Fig. 6: Report of the Global Alliance for Sustainable Building and Building Technologies, 2022 © globalabc.org

Practical Applications and Challenges

- Production and Growth Control
  The material must first be heated to 120 °C to ensure sterility; growth of the wood-decay fungus is halted at 70 °C. This process ensures that fungal growth is completely stopped in the final material.
- Buoyancy and Insulation Properties
  Due to the air content in mycelium, these composite materials offer excellent insulation and — depending on cultivation methods — can either float or sink in water.
- Repair and Adaptability
  Small damages or holes in structures can be repaired by applying fresh mixtures of mycelium material and briefly reactivating them before final deactivation.
- Mycelium Combined with Bioplastics Enhances Material Strength
  Fire safety tests in accordance with EU standards show that only the outer layer of the mycelium burns lightly, while the inner structure remains unaffected — an indicator of its resilience.
- Concrete and Recycling
  Mycelium can also serve as a natural adhesive that binds recycled concrete fragments together. This opens up sustainable reuse options for construction rubble in disaster or (post-)war areas such as Ukraine. (Fig. 4, 5)

On the pressing question of whether fungi could play a role in the reuse or neutralization of the more than 1 million tons of war and building debris in Ukraine, Vera Meyer responds with optimism: »I believe so! Whatever you offer to a fungus, it tries to grow on it. If concrete dust or small, even large concrete particles are mixed together, the fungus will attempt to grow into it, about 1–2 cm deep, before it stops due to a lack of nutrients. However, if concrete is combined with a plant or an organic source like straw or hemp, the fungus happily grows around it! We've already demonstrated this on a laboratory scale.«

Meyer's approach is transdisciplinary; her work merges science, society, and citizen science through artistic methods. Through exhibitions and installations, she makes complex technologies accessible; she brings fungal architecture into dialogue with communities, policymakers, and industry, and opens her work to public use through DIY initiatives. (Fig. 6, 7)

Their goal: to build houses from mycelium-based materials by 2030, thereby significantly contributing to reducing the CO_2 footprint of the built environment, which currently accounts for 37 % of global CO_2 emissions and 34 % of global energy consumption.

Sven Pfeiffer – Echo 1– Digital Architecture Meets the Intelligence of Mycelium

Professor of Digital Design, Planning, and Construction at Bochum University of Applied Sciences, with a focus on exploring the architectural potential of mycelium.

At the center of his research and teaching are the following questions:

- How can we use digital methods to design architectural spaces that respond more effectively to the planetary constraints of the climate crisis?
- How can innovative, circular materials support the transition toward a sustainable transformation of the built environment?
- What role do digital design and construction methods (such as artificial intelligence, 3D printing, and robotics) play in this process?

Worldwide, the use of building materials is advancing rapidly. Therefore, we need a function-oriented and differentiated use of materials. It is essential to promote circular construction systems in which all materials can be reused. (Fig. 8)

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Circular Construction Processes

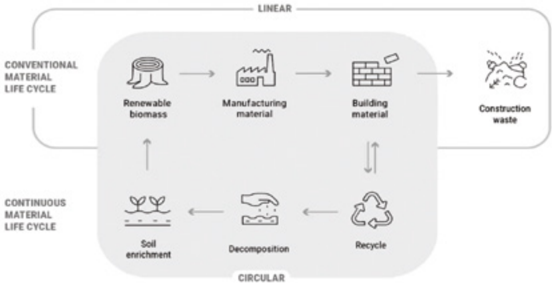

Fig. 8: Diagram of the circular production process © MY-CO X

Requirements from Architecture

Fig. 9: Layer diagram of the buildings © MY-CO X after Duffy, Brand

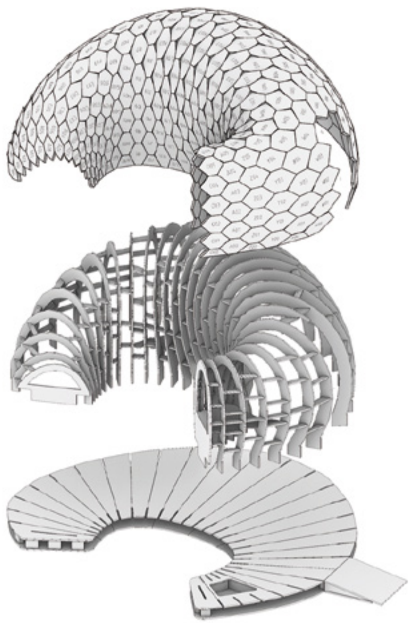

Fig. 13: MY-CO SPACE isometry © MY-CO X

Fig. 10: Exterior and interior views of MY-CO SPACE. A curved interior made of plywood arches covered with mycelium © Wolfgang Günzel, tinyBE

Fig. 11: MY-CO SPACE installation in June 2021 in Frankfurt am Main © Julius Eirund, tinyBE | Fig. 12: MY-CO SPACE sculpture at the Berlinische Galerie © Berlinische Galerie

Fig. 14-16: AI studies with midjourney © MY-CO X

Globally, research on fungal architecture is also gaining momentum. A fundamental insight in this field is the understanding that a building's structure consists of multiple layers and components with varying lifespans. Some materials last only a few decades, while the primary structural elements can endure for a century or more. It is therefore crucial to differentiate between these layers.

- The potential of mycelium-based building materials lies in their ability to bond with other materials such as wood or concrete for sustainable construction, enhancing their properties in the process. Mycelium is lightweight, exceptionally strong, and can be reused or composted after its initial life cycle.
- The adoption of circular construction processes means not only replacing traditional building materials with bio-materials, but also upgrading existing structures through extensions and modifications for continued use. The most important step is entering a regenerative cycle that allows us to reuse everything we build. (Abb. 9)

Challenges and applications:

- There are still major hurdles: developing mycelium-based materials suitable for outdoor applications and scaling up the production of fungal materials from laboratory to industrial manufacturing. Local production remains challenging, raising questions about on-site versus industrial prefabrication.
- Certification processes, such as those already in place in Ukraine, are crucial steps toward broader application.

MY-CO SPACE and Practical Experience:
Sven Pfeiffer's team gained initial experience in building with fungi through the construction of a prototype called MY-CO SPACE.

The MY-CO SPACE consists of a wooden substructure covered with mycelium panels. This construction combines the structural advantages of wood (stability, workability) with the atmospheric and insulating properties of fungal materials. The tactile and sensory qualities (texture, smell) of fungal materials differ significantly from conventional materials, creating unique interior spaces.

Currently, the team is developing a modular construction approach that allows for the production of large modules with wooden frames filled with mycelium-based elements. (Fig. 10–16)

Martin Rahmel – Echo 2 – From Lab Bench to Market: The Future of Mushroom Materials

Industrial Engineer, TU Berlin, Director of the Chemical Invention Factory, specialized in advancing inventions in the fields of green chemistry, sustainable materials, and nanotechnology

The Challenge of Technology Transfer
Bringing innovative research from the lab to the market—where it can have meaningful real-world impact—remains a major challenge. While global research output has significantly increased, its commercialization has not kept pace.

An article in The Economist (February 5, 2024) highlights that since the 1980s, the number of researchers worldwide has risen by 275 %, from 4 million to 15 million. Despite this growth, research productivity has declined by 75%. This paradox underscores a critical issue: while investments in research have surged, the expected economic returns and societal benefits often fall short of expectations.

From Idea to Market-Ready Product

- In materials science, it is unfortunately common for important discoveries to remain within scientific publications without being transformed into viable, sustainable products.
- Bridging this gap requires a structured infrastructure that supports innovations through the critical phases between early research and final industrial production. This transition can only succeed if we move beyond the laboratory and begin to align with market conditions, including the development of prototypes, scaling processes, and the industrialization of production methods.
- Opportunity for Ukraine
  Ukraine, often referred to as the »breadbasket of Europe,« produces large quantities of renewable agricultural resources. Instead of simply burning agricultural byproducts, the country has a significant opportunity to develop high-value, innovative materials. By harnessing local renewable resources and focusing on the development of sustainable materials, Ukraine can drive green economic growth and rebuild its infrastructure using cutting-edge technologies.

Fig. 18–21: Different types of mycelium, mushroom foam © Yova Yager

Fig. 22: Mushroom paper © Yova Yager

Fig. 23: Mushroom leather © Yova Yager

Fig. 17: Mycelium © Yova Yager

Yova Yager – Designing for Everyday Imagination With Fungi

A Ukrainian designer and architect, is pioneering new approaches to sustainable material design. Her work focuses on replacing traditional plastics with natural alternatives such as mycelium and hemp, highlighting the power of interdisciplinary collaboration.

YY MYCO Collection

In her project, developed in collaboration with biologists and innovators Yuliia Bialetska and Eugene Tomilin, Yager explores how natural materials can transform everyday life. The project was born after a lecture in 2019, in which she introduced future materials such as bacteria-based textiles, algae, coconut milk fibers, and fungi to a wider audience in Ukraine.

Yager has recognized the communication gap between designers, manufacturers, and scientists and is continuously working to build a dialogue to find solutions that are not only innovative but also beautiful and accessible. To bring mycelium closer to people, her team has created small, familiar household items—tableware and cutlery—made from mycelium composites. These everyday items encourage users to question material standards: Is it safe? Biodegradable? Waterproof? Durable?

Yager is committed to mycelium because it is naturally strong and inexpensive and does not require any chemical additives. With the YY MYCO Collection, her team has expanded its work to furniture, lighting, and art, using biocomposites made from mushroom mycelium and industrial hemp.

In 2021, the collection was presented at Paris Design Week, not with the immediate goal of selling, but to raise awareness and curiosity among designers and journalists about sustainable materials. The collection includes four types of material textures: fungal foam, fungal foam plastic, pressed fungal foam plastic, and fungal leather, all contributing to a future with less plastic and a stronger connection to nature. (Fig. 17–23)

Yuliia Bialetska – Fungi as a Substitute for Plastic

A Ukrainian entrepreneur leading innovation in sustainable packaging as the CEO and co-founder of S.Lab. She develops biodegradable materials that replace harmful plastics by combining agricultural waste with mycelium, offering scalable and environmentally friendly solutions on a global level.

Fungi as a substitute for plastic

S.Lab's mission is the mass production of sustainable, biodegradable materials that can realistically replace harmful packaging solutions — in particular, polystyrene.

Polystyrene takes over 500 years to decompose, pollutes soil and oceans, and enters our bodies as microplastics. In the face of this urgent ecological threat — and increasing social demand — Yuliia Bialetska and her team have developed a solution: combining agricultural waste with mushroom mycelium to create a fully biodegradable, natural material.

In this process, plant stems such as hemp or flax are shredded and mixed with mycelium, which grows through the fibres and binds them into a durable composite.

The resulting material shares the qualities of polystyrene, it is lightweight, insulating, and water-resistant, but quickly decomposes in soil, seawater, or even home compost.

Scaling the Process

One of S.Lab's key innovations is the scalability of their production. The goal is to optimize manufacturing lines and build a global network of mini-factories. Compared to conventional alternatives, producing 1 kg of our packaging helps avoid 6 kg of CO_2 emissions and saves 12 litres of clean water.

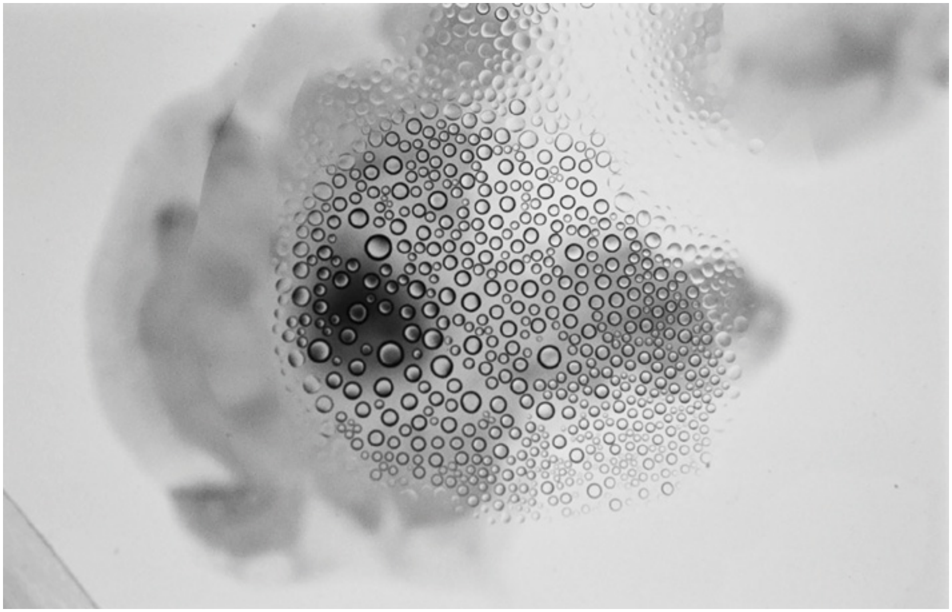

Fig. 25: Samples from the HOPE HOME • НАДІЯ Lab © Kateryna Krolenko | Fig. 26: Samples © kos losts

Fig. 24: Samples from the HOPE HOME • НАДІЯ Lab © Kateryna Krolenko

Kateryna Krolenko – HOPE HOME • НАДІЯ Fungi Lab

The HOPE HOME • НАДІЯ Fungi Lab is a grassroots initiative at the intersection of biodesign, ecology, and architecture; it is the practical consequence of the Zoom conversation on fungi as a building material; it took concrete shape during a material show on ecological building materials and interdisciplinary workshops at the Chamber of Architects in Kyiv in September 2024. In joint discussions, a central question emerged:

What if we could harness nature itself to rebuild what humans have destroyed

THOPE HOME • НАДІЯ Fungi Lab focuses on building materials made from fungal mycelium. Such materials have the potential to be CO_2-negative while also neutralizing hazardous debris. Recent studies show that fungi can encapsulate — **or even break down** — asbestos. We believe that the potential of fungi is far greater, and it is worth exploring them in depth.

The lab's activities rest on three pillars: research, education, and community building.

We believe in the future of citizen science, where everyone can contribute. Therefore, in addition to growing mycelium-based materials, we work in the following areas:

- Teaching the fundamentals of biodesign
- Hosting lectures and hands-on workshops
- Co-developing solutions for green reconstruction

Our first step is to adapt the experiences of our German colleagues to Ukrainian conditions and integrate construction debris into mycelium insulation blocks. Thanks to the Impetus Accelerator, we were able to involve students and volunteers who helped embed construction waste into these mycelium blocks.

During a workshop at a student festival organized by the local makerspace community Ostriv, we taught a group of students the fundamentals of working with biomaterials and explored symbiosis as a form of peaceful coexistence with nature — **an art that fungi have mastered!**

Our plans are ambitious

In the short term, we aim to scale up production to conduct field tests of fungal blocks in a village affected by the war. In the medium term, our goal is to train local communities to independently produce such materials and grow fungi — creating new opportunities, particularly for veterans and internally displaced persons.

Our long-term strategy is to build a nationwide network of biodesign hubs. We plan to strengthen partnerships both in Ukraine and abroad, expand into other biomaterials, and develop solutions for climate adaptation, bioremediation, and ecosystem restoration, including recovery from the consequences of war.

Why is this important?

Ukraine has found itself on the front line of not only the fight for its freedom, but also for a sustainable future amid war and climate change. The problems we face today — soil and drinking water contamination, disrupted energy grids, and the environmental consequences of destruction are challenges the entire world may soon encounter.

This project is an attempt to prove that reconstruction can and must be green. We believe that innovations born in times of crisis can offer scalable solutions to help communities worldwide become more resilient and thrive — even in the darkest times.

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Alessandro Volpato – Every Kitchen Can Be Turned into a Mushroom Lab

Biologist, educator, developer of open-source tools, and mediator between science and society, with a focus ranging from citizen science to biotech innovation to develop new ideas for industry. »I build tools that make science accessible.«

Do-it-yourself approach • Open Access and Open Source
All instructions are freely available online, and anyone can edit, modify, and reuse them for their own purposes. Impressive results have been achieved in workshops with youth organizations, inclusion NGOs, students, and start-ups. Architects and designers, in particular, are interested in the easy-to-apply ecological and collaborative solutions of recyclable and compostable mushroom-based materials for sustainable practice.

How can I recreate the equipment of a professional mushroom lab to try out my own ideas?
In fact, many of these tools can be replaced by everyday household items without compromising technical results; every kitchen can be turned into a mushroom lab. This practice has become so widespread that there is now a wide range of specialized, affordable products that allow enthusiasts to set up their own home lab.

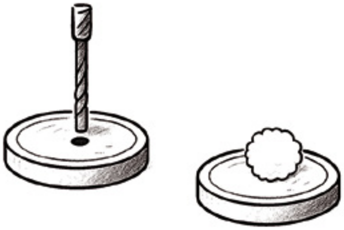
Basic tools • everyday ingredients
Various glass containers, scalpels, a pressure cooker, a still-air box, and everyday ingredients such as gelatin powder, malt extract, potatoes, or grains make the kitchen lab ready for use.

In the »Mind the Fungi« project by Vera Meyer and others, in cooperation with the Department of Applied and Molecular Microbiology at Technische Universität Berlin, we translated lab protocols into kitchen-friendly recipes. These allow architects, designers, artists, and anyone interested to produce mushroom-based materials according to their own ideas.
Here is a small cabinet of curiosities:
www.top-ev.de/mushroomresources

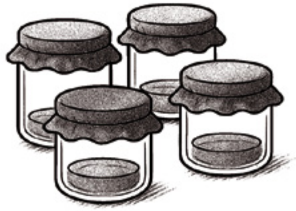
Recipe – How to Cultivate Working Material from Wild Mushrooms

Although it looks like a simple cooking recipe, it meets the high standards of the Food and Drugs Administration Laboratory Manual for Mycology, which serves as the national reference standard in the United States.

❶ Dissolve 2 g agar powder (½ teaspoon) and 2 g malt extract (for beer brewing) in 100 ml water and mix well .

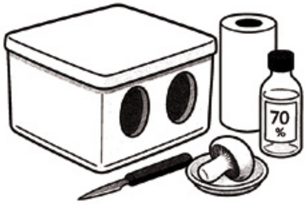


❷ Drill an 8 mm hole into the lids of screw-top jars (jam, pickles, mustard, etc.) and seal it tightly with cotton.



❸ Fill the jars with about half a finger's width of the prepared liquid, close them, and cover the lid with aluminum foil.

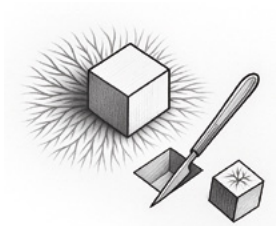
❹ Sterilize in a pressure cooker for 40 minutes, then let cool.



❺ Sterilize a still-air box (e.g., an IKEA storage box with two hand holes) and knife/scalpel with alcohol .

❻ Wearing household gloves inside the still-air box, cut three 5x5x5 mm pieces of mycelium from inside the mushroom stem.

❼ And place them on the now solidified agar-gelatin.



❽ Once the mycelium has grown about 2 cm, cut out a 5x5x5 mm cube of agar with mold-free mycelium.

❾ And transfer it into a new screw-top jar with agar-malt extract .

✎

Participatory Architecture from Reused, Found, and Leftover Materials

Wherever war, destruction, or economic change leaves traces, materials remain: fractured bricks, bent steel beams, discarded machines, entire building shells. What appears to be debris can become the starting point for something new. Reusable and participatory architecture understands these remnants as a resource, not only material, but also social. It is about collective processes: building together, do-it-yourself methods, neighbourhood initiatives. HOPE HOME • НАДІЯ shows that the focus is not on the completed building, but on the path toward it, the involvement of residents, the experience of collective action, and the possibility of regaining self-empowerment.

The approach remains sensitive to context. It responds to local conditions and to the question of how to deal with the remains of destroyed houses. In this way, it produces not only physical structures, but also social spaces, places of exchange, participation, and community.

Benjamin Förster-Baldenius – An Architect Who Does Not Build

Architect, situation designer, cultural activist, founding member of raumlabor berlin (1999), and co-founder of the Floating ~~University~~ in Berlin.

Participatory building and intervention practice through four case studies

Repair Reuse Recycle

Re-use and repurposing have a very long history. For centuries, we have encountered examples of dismantled and recomposed buildings. Sometimes it is only small architectural fragments that are taken along and displayed as spolia — trophies of victory, like the French cannons at the Berlin Victory Column. In other cases, entire buildings have been dismantled and reconstructed elsewhere, such as the Ishtar Gate in the Pergamon Museum.

Other buildings are simply adapted and completely transformed through minimal intervention, like the Hagia Sophia in Istanbul, which after 1,000 years as a Christian church became a mosque for the next 500 years with only the addition of a few minarets.

During times of conflict, destroyed buildings are often reused: as shelters, factories, schools, infirmaries, hideouts, depots, barracks, prisons, and command posts. After war, many of these buildings stand empty until new or former uses reoccupy them. Whether through demolition, conversion, renovation, or new construction, enormous quantities of material are constantly being moved, reused, recycled, or piled up into mounds of rubble, sometimes even dumped into the sea for land reclamation.

Resourceful architects, confronted with scarcity and mountains of debris, have always developed surprising ideas. The Marseille architect Fernand Pouillon used sewer pipes to construct refugee shelters. In Berlin, during the construction of Stalinallee, Henselmann and Paulick relied heavily on reused bricks. At the Hebbel Theater, an entire row of windows was replaced using gin bottles.

Use what you find

A new kind of baroque emerges when one works with the leftovers that wars leave behind. Aircraft parts, bunkers, fuel depots, mobile field equipment, vehicles, weapons, ammunition, combined with rubble, are assembled into new structures. This demands a technique of bricolage, which is rarely taught in architectural education.

Footnote: Bricolage (from French bricolage – tinkering, improvisation) refers to a method of creation using existing, often heterogeneous materials, objects, or fragments, combining them into something new.

Four case studies

Realised in peacetime by raumlabor berlin, these projects reveal the potential to preserve the past, to tell stories, and to generate new forms of community even during construction.

- **The Third Space (Bochum, 2018–2020)**

The task was to create, for the Ruhrtriennale 2018/19/20, a place for large-scale performing arts within the monumental halls of the Ruhr's industrial heritage, a space that would also accommodate small, quiet, experimental formats. A modular construction kit was developed so that the space could be adapted each year to site and programme.

At its core was a decommissioned Transall transport aircraft from the German Air Force. Also included were a fuselage section from an Airbus A220, discarded seating shells from various Rhineland football stadiums, accordion joints from Berlin articulated buses, washing machine windows, and plywood. In a local workshop, connecting elements were made: tables, chair legs, furniture, stairways, even a table tennis table. In the end, a space was created that, for a few weeks each year, could be reassembled in different configurations on the forecourt of the Jahrhunderthalle.

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Fig. 1: Third Space 2018, Bochum © raumlabor

Fig. 2: Plastic Democracy 2021, Düsseldorf © Rainer Schlautmann

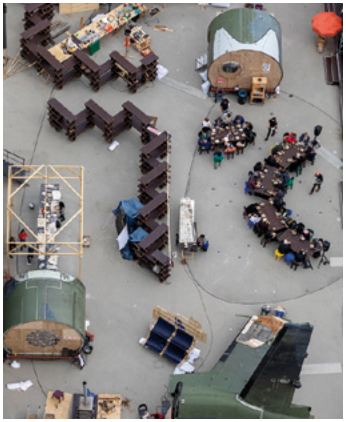


Fig. 3: Plastic Democracy 2021, Düsseldorf © Rainer Schlautmann

Fig. 4–6: Neocdomousse 2016, St. Nazaire © raumlabor

Fig. 7: [Working on] Common Ground 2022, Pristina © Adthe Mulla

Fig. 8: [Working on] Common Ground 2022, Pristina © raumlabor

Fig. 9: [Working on] Common Ground 2022, Pristina © Tea Marta

• Neocodomousse (Saint-Nazaire, France, 2016)
{neo = new, co = together, domo = house, mousse = moss}
A German World War II submarine bunker, whose massive presence once led to the destruction of the entire city and later shaped its reconstruction, was to be repurposed. From this monumental structure of concrete, a place for communal living was to be imagined, developed, and perhaps even built. The materials were sourced exclusively from waste and scrap regularly washed ashore or dumped in the harbour — a radically ecological and resource-conscious concept at the intersection of art, architecture, urban development, and social experiment.

Saint-Nazaire is sustained by its fossil industries. Here, the world's largest cruise ships are built, along with submarines, warships, aircraft, petroleum, and gas. Vast scrap yards contain the metallic remnants of the French nation, waiting to be shipped around the world. The end of the fossil age would strip Saint-Nazaire of its economic foundation.

For a vast art space inside the former submarine bunker, we proposed a workshop for new communal architecture using discarded materials. Each day, three truckloads of scrap were delivered into the hall, processed by a team of twenty specialists: walls made from refrigerators, washing machines, and dumpsters; living cells clad with gutters, circuit boards, licence plates, and Tetra Paks; inflatable domes made from old uniforms; entrances constructed from window frames, and more.

• A Common Ground (Pristina / Kosovo, 2021)
The task here was to support the capital of this small nation, with its large diaspora investing heavily in "concrete gold," in securing a central urban area for collective interests. We decided to salvage stones from the kilns of the former brick factory, scrub them, glaze them, fire them, and use them to create spaces for all kinds of gatherings. During a summer school, with 120 hands, we built a kitchen, a workshop, a pool with a water-filtering landscape, a garden, and a parcours through the history of the site. The brick factory that produced the very bricks from which Pristina was once built has stood silent since the Kosovo War. Just before we began our work, it transferred ownership from the state trust to the city. The nomadic biennial Manifesta used this moment to speculate with us about the cultural future of the site. We committed ourselves to realising the project using only materials found on site, earth, scrap, and brick.

• Floating ~~University~~ (Berlin 2018 to present)
In a centrally located rainwater basin, the task was to establish an offshore campus for cities in transformation: writing a concept, searching for funding, building alliances, convincing stakeholders, and above all, enduring, enduring, enduring. Once everything was finally secured, a strong team was assembled, work began, and it never truly stopped. Together with so many contributors that we can no longer remember them all. Since 2019, it has been operated by Floating e.V.

The Floating ~~University~~ is not a recycling project. It is a collectively supported place of learning within a multi-coded space: an element of urban infrastructure (a rainwater reservoir), a habitat for numerous non-human life forms, a place of recreation for a hundred allotment gardeners, and a university for all. Academic and non-academic forms of learning intersect here. Research is carried out through situational, site-specific, embodied, and scholarly practices, addressing questions of nature-culture and urban practice. All aspects of being and dwelling in the city are examined alongside one another and viewed through an intersectional lens. Terrestrial!

✎

Fig. 10: Floating ~~University~~ Opening night
© Victoria Tomaschko

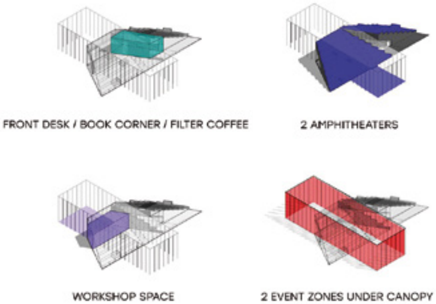
Fig. 11: Floating ~~University~~ 2018 © Alexander Stumm

Fig. 12: Floating ~~University~~ 2018 © Victoria Tomaschko

Fig. 13: Floating ~~University~~ 2019, Climate Care Festival
© Lena Giovanazzi

Fig. 15, 16: Micro-rationality © Ivan Protasov

Fig. 14: Floating ~~University~~ 2018, closing ceremony
© Daniel Seiffert



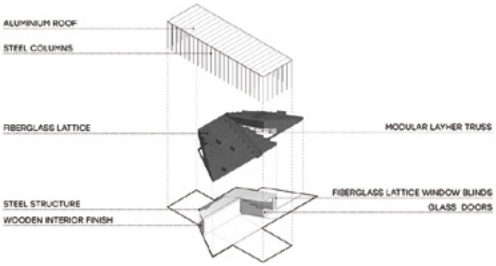


Fig. 17, 18: »House of Europe«, mobile project © Ivan Protasov

Ivan Protasov

An architect based in Kyiv, Ivan Protasov founded the office Prototype in 2020 — an architecture and design studio working with the concept of “micro-rationality,” a methodology that places local conditions, available materials, and adaptable use at the centre of the design process.

The Prototype team applies the principle of micro-rationality, a method focused on the specific conditions of place and on materials available on site. This approach leads to spatial solutions designed to change, adapt, and be reused over time. The studio works on projects of various scales, with a strong emphasis on public and community-oriented developments. The goal is always to address the immediate needs of a place while respecting its unique context. During construction, the process deliberately leaves room to adjust outcomes and re-use existing resources.

A defining example is the Ukrainian-Danish Youth Centre in Kyiv, completed in 2022 during the war. Located in an 18th-century building formerly used by the Ministry of Justice, Prototype created flexible spaces supporting youth initiatives and cultural exchange in Ukraine. Numerous small rooms were opened up to allow for versatile use. Demolished structures and recovered construction debris were sorted, recycled, and reintroduced into the project.

From the outset, partition walls and plasterboard structures were dismantled, photographed, sorted, and categorized. This formed the basis for reuse: furniture made from plasterboard and wood, reinforced with polystyrene for stability and insulation; seating constructed from plastic pipes and carpets; lamps and furnishings assembled from old aluminium components and light fixtures.

The resulting open spaces connect past and present through the deliberate integration of recycled materials. They remain adaptable, capable of hosting multiple scenarios and uses.

»House of Europe«, Mobile Project / Ukrainian Pavilion

The House of Europe project was developed between 2020 and 2021 as part of the Ukrainian-European cultural association and was realised through an architectural competition. The aim was to create temporary spaces in towns and villages with limited cultural infrastructure, serving for one to two months as venues for events, exchange, and information. The pavilion functioned both as a platform for cultural programmes and as a form of outreach for the organisation’s future initiatives.

The concept is based on a modular structure that can be flexibly adapted to different urban settings. Two main units, open boxes with roofing that function like an amphitheatre, and enclosed containers, form the core system. Depending on the location, they can be arranged in various configurations, transforming public spaces into cultural meeting points in a very short time.

The construction materials included Layher systems, modular, innovative scaffolding, protection, and event systems produced by Layher, known for their safety, flexibility, and cost efficiency. Made of steel or aluminium, they offer high load-bearing capacity, while fibreglass grids, although not recyclable, are used for their durability and resilience. Transparent elements provide visual permeability.

The pavilion is transported by truck, assembled on site, and can be dismantled again within a short period. Its first installation took place in 2021 for six weeks on the central city square of Mykolaiv.

Fig. 19: Wysing Arts Centres © Folke Köbberling

Fig. 20: Building materials center, wooden slats, roofing felt, found materials, 2007
© Folke Köbberling and Martin Kaltwasser

Fig. 21: Werdplatzpalais, 2007, wooden slats, roofing felt, found materials
© Folke Köbberling and Martin Kaltwasser

Fig. 22: Temporary structures, 2006, wooden slats, roofing felt, found materials
© Folke Köbberling and Martin Kaltwasser

Folke Köbberling

Abfall als Ressource!
Visual artist and architect, Professor of Artistic Design and Director of the Institute for Art in Architecture at the Technical University of Braunschweig. Her work focuses on public space interventions, sculptural installations, and participatory architectural projects.

Folke Köbberling works with materials that appear as waste or residue in cities and rural areas. Every material gains value through its use. She employs these materials in artistic installations and participatory construction projects.

Central to her concept is bricolage — creative improvisation with what is available. It is not about precise planning and strict execution, but about a flexible approach: having a vision of the goal, working with locally available materials, and adding only minimal supplements when necessary. The entire process is understood holistically, including reuse and transport of materials. She developed this approach together with artist Martin Kaltwasser.

Wysing Arts Centre, Cambridge, UK
Near Cambridge, Köbberling and her team, working with around forty architecture students, built the Wysing Arts Centre, a communal house and performance space for art and theatre. The starting point was the idea of creating a flexible cultural building in DIY construction using materials from building sites and local surplus resources.

The team had seven weeks to realise the project. Nearly half of that time was spent searching for an alternative to a conventional concrete foundation, which proved problematic due to strong winds. In the end, the foundation was built from wooden pallets and excavated soil. The original plan of a 4 × 8 m structure grew into an octagon measuring 6 × 12 m, making it possible to add further expansions in the future.

The construction site became a place of learning. The building was not defined by a pre-set aesthetic design, but by the properties of the materials, their availability, and limited time. Participants experienced a steep learning curve in material understanding and practical craftsmanship.

The construction costs of the new Wysing Arts Centre were around £5,000 (approx. €9,000). Pallets were used as stairs, shelving systems as railings, linoleum sheets as floors. Despite its improvised construction, the structure still stands today, nearly twenty years later, in good condition. It is valued for its acoustics and continues to be used as an amphitheatre or festival venue. Owls have nested in it, which means it may not be dismantled after two years, a compelling example of coexistence between architecture and nature.

Werdplatz Palace, Zurich 2007, the Micafil Branch, Zurich 2008
In 2007, an entire block of social housing in Zurich was demolished because it no longer generated sufficient profit. Together with her team, Köbberling collected, cleaned, and sorted the remaining debris and materials. In an art centre in the city centre, these materials were transformed into a building-material and information centre, demonstrating that what is commonly treated as worthless can be re-layered, installed, and made visually and physically accessible. Every single piece was catalogued and marked for potential future reuse.

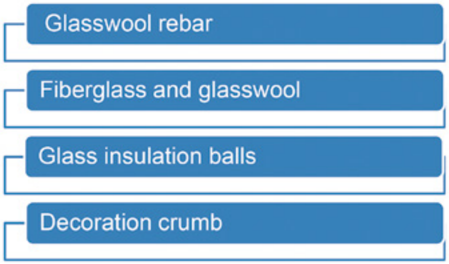
Here too, a temporary structure was created using the principles of bricolage, assembled from shelves, doors, construction parts, and other leftover materials. The construction was developed through a studio-like process, driven by what could be repurposed and integrated.

A year later, in 2008, the same materials were used in the construction of the Micafil Branch, a participatory project in a suburban district of Zurich. This time, the work was created together with around forty children. They built according to their own needs, adding five doors that playfully expanded the space.

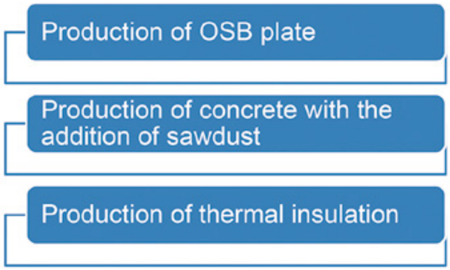
The project followed, like many of Köbberling's works, the principle of »flying structures.« In Switzerland, the law permits the construction of temporary buildings up to a volume of 72 m³ without a building permit. This allows structures to be realised quickly and with locally available materials, as social spaces that demonstrate how demolition materials can gain new value.

Material Practice & Personal House Project
Folke Köbberling sources her materials from her own exhibitions, from demolition sites, or through local construction companies. At the core of her approach is always the same question: Which materials are easily available on site, and how can they be transported to the building location? She often handles transport herself, by bicycle, conserving resources and acting ecologically.

Possibility of glass recycling



Possibility of wood recycling



Possibility of mineral material recycling

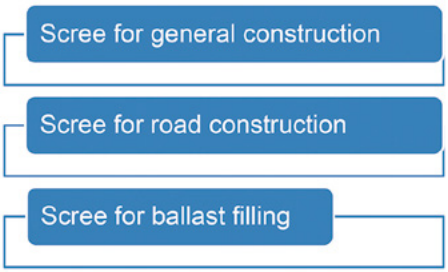


Fig. 23–25: © Oleksii Komandyrov

Oleksii Komandyrov

Civil engineer and head of the Department for Volume, Quality, and Construction Cost Analysis at the Institute of Forensic Expertise of the Ministry of Justice in Kyiv. Since 2014, he has been analysing the consequences of Russian attacks on Ukrainian cities. In 2022, he was awarded the title »Honoured Builder of Ukraine«.

While in most European countries forensic engineering is not a distinct discipline, in Ukraine it is firmly established. Its purpose is to translate technical engineering knowledge into legal language and support the judiciary in securing evidence in construction-related cases, both before national and international courts.

Since 2014, in the Russian-occupied Luhansk region, Oleksii Komandyrov has been dealing with the consequences of attacks on Ukrainian cities: missile and artillery strikes, explosions, and fires that have destroyed entire building structures. His work includes analysing such ruins, assessing the extent of damage, and determining to what degree materials can be reused. In 2022, he was recognised as an Honoured Builder of Ukraine.

At the heart of his research lies the question of how building materials can be recycled after destruction and integrated into reconstruction. Worldwide, up to 90 percent of construction debris can be reused — in Denmark approximately 81 percent, in the Netherlands 90 percent, in the United Kingdom 45 percent, and in Finland 43 percent. In Ukraine, however, the rate is currently only 6 percent, despite the enormous potential.

What happens to the remaining 94 percent that are not recycled?
They end up in overcrowded landfills, such as those in Kyiv or Lviv. Without alternatives, the waste management system is at risk of collapse.

How are the 6 percent being recycled?
In Hostomel, a French company is conducting a pilot project in which concrete is produced from construction debris. This concrete is reused directly on site, eliminating the need for transport and reducing associated costs.

Reuse in wartime differs significantly from civilian demolition.

- Mineral materials (concrete, brick, stone) can be processed and reused as gravel or aggregate.
- Wood, glass, and metals can be further utilised depending on their condition.
- Plastics, such as those from window frames, can be recycled into furniture — including beds, benches, or modular shelving for use in air-raid shelters.
- Asbestos, which became widespread in the Soviet Union from the 1970s onward, poses a particular danger. It can only be reused in very limited ways and exclusively in areas without direct human contact.

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Climate-Friendly Resource Utilization

In addition to the rediscovered building material's wool, hemp, straw, and reed, which were the subject of bilateral knowledge exchange, HOPE HOME • НАДІЯ also works with classic recycling strategies, including artistic methods.

Fig. 3: Ecosystem of NO WASTE UKRAINE

Anastasiia Zhuravel – Conscious ConsumptionAs a Tool for Social and Ecological Change

Urban Studies Researcher, Berlin. She holds an M.Sc. in Urban Management, Technische Universität Berlin and completed the Harvard Leadership course for ›Sustainable Reconstruction of Ukraine‹. Her research focuses on critical urban studies, civic action, urban governance, and sustainable systems. She founded the International Design Lab Berlin, ›re:imagining your city‹ and is co-founder of the charity LASKA in Kyiv.

LASKA — a social and charitable project based in Kyiv, Ukraine, aimed at reducing negative environmental impact through ecological and social initiatives that engage the community in active change. It promotes environmental awareness by implementing practical solutions for waste textile reduction, developing urban projects, and supporting social initiatives.

LASKA collects used clothing and redistributes it with care. About 70 % of the donated items are sorted and given directly to those in need: children's homes, shelters for the elderly, refugees, and people living in vulnerable conditions. Only 20 % of the items are sold in their secondhand shops, profits that help sustain the project's infrastructure. Around 10% of unusable textiles are sent for recycling. (Fig. 1)

Beyond donations: a culture of responsibility
Unlike anonymous street bins, LASKA uses a partner-based container model. Containers are placed in selected venues like cafés, coworking spaces, and stores. This curated system turns donations into acts of intention and encourages people to prepare items with care not as waste, but as valuable contributions to a shared cause.

Charity as a third partner
At LASKA, charity is more than a mission, it's considered a co-equal business partner. Their economic model factors in direct giving: from tailored humanitarian aid packages to emergency support, such as donating over 100,000 UAH to the Ahmatdet children's hospital after a missile strike. Every two to three months, LASKA is able to channel part of its revenue into impactful donations.

Scaling impact through collaboration
With the help of local partnership, LASKA has expanded far beyond Kyiv. Ukrainians from any region can now send donations to LASKA free of charge. This national network allows the team to reach displaced populations and communities affected by war, delivering needed goods across the country.

Upcycling and social entrepreneurship
LASKA has also embraced upcycling, creating new products from unsellable textiles. Elderly women weave rugs from fabric scraps, which are then sold and profits returned to the makers. Accessories, hats, and bags crafted from residual textiles have found a second life and purpose. They also organize pop-ups where fashion brands sell sample items or production surplus, turning potential waste into charitable fundraising. A recent event raised over € 2,000 to support fire victims. The measurable result: over 770,000 kg of clothing reused and more than 2 million UAH donated to charitable causes.

Circular fashion with a mission
In a country where 6 % of all waste is textile and state-run recycling programs are nearly absent, LASKA is filling a crucial void. Sorting up to ten tons of textile monthly, they position themselves as Ukraine's first circular textile system, ensuring every item goes somewhere meaningful. Their ambition is clear: transform fast fashion waste into circular action, community aid, and climate resilience.

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Fig. 1: LASKA project flow © Anastasiia Zhuravel

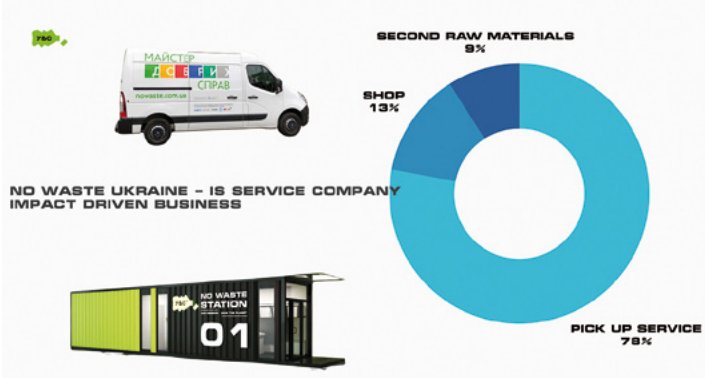

Fig. 5: The waste separation capsule © NO WASTE UKRAINE

Fig. 4: Garbage cans in Kyiv © NO WASTE UKRAINE

Fig. 2: Landfill with textile waste © LASKA

Fig. 6: Sorted materials © https://kunst-stoffe-berlin.de/portfolio/

Yevheniia Aratovska – A grassroots Movement Redefining the Future of Waste in Ukraine

Yevheniia Aratovska, Founder and Executive Director of No Waste Ukraine, Kyiv; she has strong experience in leading environmental initiatives and large-scale transformation processes. She plays

a key role in developing and implementing innovative strategies, systems and public infrastructure for sustainable waste management; combining vision with action, promotes strong civic engagement

and advocates for the circular economy in a challenging political environment.

While many still view garbage as the end of a product's life, Yevheniia Aratovska sees it as a beginning. As founder of No Waste Ukraine, she leads a social enterprise transforming public perception and infrastructure around waste management in Ukraine. (Fig. 3)

Recycling as civic resistance
In a country with over 30,000 landfills, only 6,000 of which are legal, burying waste remains the cheapest option, just €5 per ton. As a result, 94 % of household waste is buried, 3 % recycled, and 2 % incinerated. Aratovska's initiative stands in defiance of this status quo, creating not only infrastructure, but hope.

The first civic sorting station
When No Waste Ukraine opened its first public sorting station, people arrived by taxi with sorted bags, a powerful symbol against the myth that Ukrainians »don't want to recycle.« They proved that given the opportunity, people choose responsibility.

Reimagining waste infrastructure
The project's signature initiative is the waste sorting capsule, a secure, transparent, educational space where people can sort their recyclables with dignity and traceability. Designed to avoid misuse and contamination, these capsules offer a radical alternative to chaotic, unreliable street bins.

The goal: turn sorting into satisfaction, not frustration

Creating an ecosystem of sustainability
No Waste Ukraine operates as a social business with several branches: educational programs, school tours, corporate training, and pickup services. These services sustain the organization financially in the absence of systemic producer responsibility laws. They also collect plastic and aim to turn it into usable products, like tabletops, tiles, and more, creating a visual narrative of waste transformed into value.

Facing systemic barriers
Despite strong public interest, state support is absent. Waste transport companies and packaging producers dominate the market without accountability, and the Ministry of Environment lacks the authority to enforce change. No Waste Ukraine continues to build a framework from the ground up.

A portal to a different reality
Their sorting station is more than a recycling point; it is a portal of transformation, where citizens experience what a sustainable future could feel like. Visitors leave with a new understanding: waste is not a problem, it's a material.

Vision for the future
Their roadmap includes developing design objects from collected plastic, exporting best practices to Europe, and launching educational tools for businesses. The dream is to scale the capsule model globally and introduce a system where sorting becomes the norm, not the exception. (Fig. 5)

No Waste Ukraine's message is simple but radical:
»We don't wait for permission. We build the future we believe in.«

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Fig. 7: Beverage cartons © Alexa Kreissl

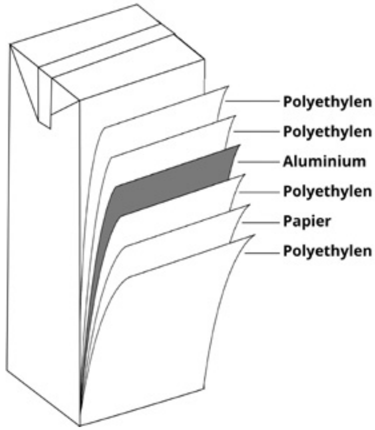

Fig. 8: Structure of a Tetra Pak brand packaging Aseptic, own illustration based on Wikipedia, »Beverage carton« © https://de.m.wikipedia.org/wiki/Getr%C3%A4nkekarton

Fig. 9–14: Modular Weaving – Open Use System (2024), HOPE HOME • НАДІЯ Material exhibition at the Kyiv Chamber of Architects ©Natalia Azarkina

Corinna Vosse — Infrastructure for Circular Building in a Resource-Depleted World

What happens when you treat building materials not as disposable commodities, but as long-term societal assets?

Dr. Corinna Vosse leading expert on resource-efficient and circular construction systems, Berlin. In 2006, she founded 'Kunst-Stoffe' and the 'Akademie für Suffizienz' (Academy for Sufficiency) in Berlin, pioneering the reuse of building materials through decentralized infrastructure, education, and local networks. She is creating the physical and intellectual infrastructure for a radically different way of building based on reuse, access, and collective action.

Her vision: We already have enough materials for the next 20 years — we just need the systems to use them wisely.

Saving what already exists
The goal is simple but powerful: preserve and reintroduce existing materials into new cycles of use. That includes everything from windows and doors to clay and old wood. This doesn't mean simply recycling, but carefully collecting, preparing, and rethinking how these materials can be used structurally and creatively.

Material rescue as climate action
In Germany alone, each person is responsible for around 4.3 tons of waste per year — the majority of it in construction. Vosse's work focuses on reversing this through public access to reclaimed materials and by shifting perception: these are not waste objects, but resources that can be part of a shared, local economy. (Fig. 6)

No market? Build a new model
Because reclaimed materials are often less "competitive" than new ones, Kunst-Stoffe bypasses traditional markets. Instead, it fosters local exchange systems and open workshops where the public can learn, repair, design, and prototype using rescued components.

Spaces for transformation
The project operates from multiple locations and supports workshops in urban centers, often in former industrial or brewery buildings. The aim is to make repair, reuse, and material learning visible to show that a different kind of economy is possible.

Education through doing
Workshops provide hands-on experience with tools, techniques, and circular design. Artists-in-residence bring experimental and aesthetic approaches, while vocational training teaches real skills in working with rescued materials.

From clay presses to modular walls
Innovations range from manual presses for clay building to modular components made of old windows and doors. The guiding principle is low-energy, human-scale technology that empowers rather than automates.

From local to global
Vosse's work is networked with similar initiatives in Switzerland, Austria, and beyond. She contributes to European knowledge-sharing platforms and develops guides for transferring reuse systems internationally. Her model has inspired similar spaces from Dresden to Kigali.

Economic reality vs ecological necessity
»Our economy makes labor expensive and resources cheap,« Vosse notes. »So circular systems only work with structural political support.« Until that's widespread, these projects serve as working prototypes for a future economy.

Alexa Kreissl – Rethinking Packaging Waste as a Building Material

Alexa Kreissl is a visual artist, researcher, and doctoral candidate at the Technical University of Braunschweig, specializing in sustainable design and material experimentation. Her work focuses on the transformation of residual and waste materials—particularly composite

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Fig. 15: Curtain made of beverage cartons, HOPE HOME • НАДІЯ Material exhibition at the Kyiv Chamber of Architects © Natalia Azarkina

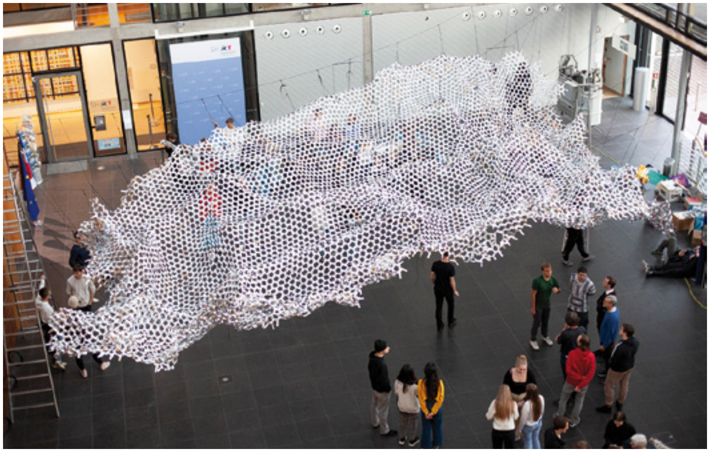

Fig. 16, 17: Let it grow // Students design for tomorrow (2022), Institute for Architecture-Related Art (IAK) of the TU Braunschweig at the State Representation of Lower Saxony, Berlin © IAK, Kurt Mundahl materials—into modular architectural elements using practical, low-tech methods. By combining art, education, and environmental activism, she paves the way towards a circular economy and community participation.

(Re)connection through new uses
Alexa Kreissl sees value in what others consider trash, focusing on one of the most ubiquitous and overlooked waste products: beverage cartons (Tetra Pak). Using experimental weaving techniques, she has developed a system to transform this composite material into flexible, scalable, and aesthetic architectural components.

Her method is based on modular weaving, a system that connects ring-shaped elements without glue or seams. The resulting net can be endlessly expanded, redesigned, and reused as textiles, curtains, room dividers, and sunshades.

According to the company itself, Tetra Pak operates in over 160 countries worldwide. In 2022, 193 billion packages were sold worldwide. tetrapak.vom tetrapak.com+1 This global presence makes Tetra Pak a huge player in the food packaging industry for products such as milk, juices, and other beverages, creating a global waste problem.

From waste to structure
How do architecture students learn to better understand the life cycle, composition, and potential of everyday materials? How do they acquire material competence? The globally used beverage carton proved to be the perfect case study: durable, complex, composite, and massively underutilized.

Collaborative prototype development
A workshop with 150 architecture students focused on weaving together thousands of collected beverage cartons to create prototypes on an architectural scale. The woven fabrics have since been used as interior curtains, on facades, and in performative installations.

Sunlight and shade
One focus is on sun protection. The woven curtains filter up to 50 percent of sunlight, providing passive cooling. Further tests are therefore focusing on insulation performance and weather resistance.

Material without language
The method can be taught playfully without words, through gestures and demonstrations. This makes it ideal for collaborative design, especially in crisis regions where access to formal education is limited.

From waste to wonder
Whether made into balls for children's workshops or room dividers, the designs show that a discarded beverage carton can be both structure and history. Alexa Kreissl's goal is not only reuse, but also to empower people to transform waste into protection, function, and even joy.

A method that is open to the world
The system works not only with Tetra Pak beverage cartons, but also with plastic bottles and much more. Its open-source nature invites adaptation. A collaboration with NO WASTE UKRAINE in their educational work and upcycling workshops is planned.

Research in action
Kreissl is currently testing the behavior of the material under UV radiation and moisture, with a view to outdoor applications. Even though challenges remain, the potential is clear: it lies in the method of transforming packaging into protection and waste into resilience. Her approach combines handicraft, architecture, and activism, demonstrating how material experiments can become a form of collective healing. (Fig. 8–13)

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1 L Drink Carton Collection

- Usually found at home or in household waste
- Clean the cartons as soon as possible
- Ask friends, family, or a nearby café if they can temporarily collect drink cartons – preferably with a silver-coated interior
- Pick them up promptly
- Keep the cartons as flat as possible; this makes them easier to clean and handle

❶ Open the carton at the top and bottom by cutting off the seals with scissors.

❷ You now have an open tube that can be cleaned from the inside using a sponge and soapy water. Let it dry completely.

❸ Fold the cleaned carton flat along the existing folds and stack for storage.

❹ Cut the tube into rings about 2.5 cm wide. This should produce 7–8 closed rings, leaving out the top and bottom.

❺ Carefully turn the rings over so that the aluminium-coated side is on the outside.

Fig. 13: Photos © Alexa Kreissl

War damage and Challenges for Reconstruction

The Russian war of aggression in Ukraine has not only caused immense human suffering and damage to infrastructure but has also resulted in massive climate impacts. According to a study by the Initiative on Greenhouse Gas Accounting of War (IGGAW), at least 175 million tons of CO_2 equivalents were emitted in the first two years of the war, more than the annual emissions of 175 countries. One-third of these emissions, around 58 million tons—are attributable to reconstruction using conventional materials such as concrete and steel. The other two-thirds result from CO_2 loads caused by direct military operations and their consequences, such as fires, displacement, and refugee movements.*

This highlights the urgency of turning to climate-friendly alternatives such as bio-based building materials in reconstruction, in order to reduce the climate burden and ensure a sustainable future. It makes clear that reconstruction is a major driver of greenhouse gas emissions unless climate-friendly alternatives are more widely adopted (Reuters, 2024; The Guardian, 2024).

This is where HOPE HOME • НАДІЯ comes in, with hemp, straw, clay, sheep wool, fungi, willow, and reed. These materials sequester CO_2, require less energy-intensive production processes, and help to significantly reduce the climate impact of reconstruction.

* Preliminary note:
The data are from July 2024, collected during the Zoom series that forms the basis of the material book; more than a year later, the scale of war damage is likely to have increased many times over.

Lesia Zub – On the Impacts of War on Nature

Biologist, Head of the Laboratory for Protection and Reproduction of Plant Life, Director of the Department of Biology at the National Academy of Sciences of Ukraine

At first glance, it may seem inappropriate to speak about the environment and biodiversity in the face of human loss and social catastrophe. Yet precisely in the midst of acute crises, it is important to also record ecological damage, as it affects both the present and future generations. The Ukrainian Ministry of Environmental Protection identifies biodiversity as a key factor for the country's recovery and stability.

The ecological debt of this war will therefore burden not only decades, but generations. According to the official portal of the Ministry of Environment, the environmental damage caused by the war was estimated at over 4.644 trillion hryvnias (about 108 billion EUR) as of July 2025.

For comparison: the entire Ukrainian state budget in 2021 amounted to about 1.1 trillion hryvnias in expenditures and 1.3 trillion in revenues.

Ukraine's nature reserves alone, the country's most important ecological sanctuaries, have suffered damages of around 15 billion EUR. More than 20 percent of these protected areas have been directly affected by the war. Ten of the nineteen nature reserves and three of the five biosphere reserves (Askania-Nova, Bile, and Chernobyl) have been harmed by military actions or occupation.

Wetlands, ecosystems closely interwoven with both water and land, are particularly vulnerable. To protect the most valuable of these areas, the Ramsar Convention was established in 1971. In Ukraine, such protected areas cover around 675,000 hectares; about 68 percent of them, roughly 470,675 hectares, have been damaged by the war. (Fig. 1)

The restoration of these biotopes will take decades:

- Since the beginning of the war, fires have destroyed more than 2.4 million hectares of land, including 330,000 hectares from the state forestry program. Particularly affected are thousands of hectares in the national parks Kreminna Forests, Biloberezhzhia of Sviatoslav, Holy Mountains, and in the Chernobyl Biosphere Reserve.
- The Kreminna Forests were considered the largest natural forest massif in Ukraine, today they are completely burned

Fig. 1: Fires in Ukraine in 2022. NASA Map

Fig. 2: Europe's largest orchid field, destroyed by flames
© Presentation Lesia Zub

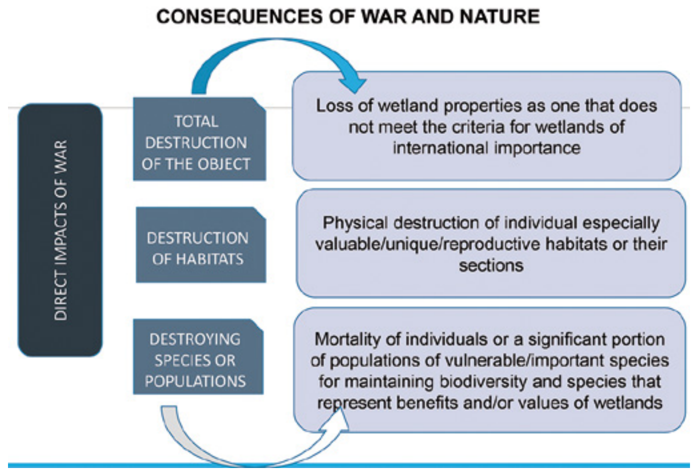

Fig. 3: Effects of war and nature © Presentation Lesia Zub

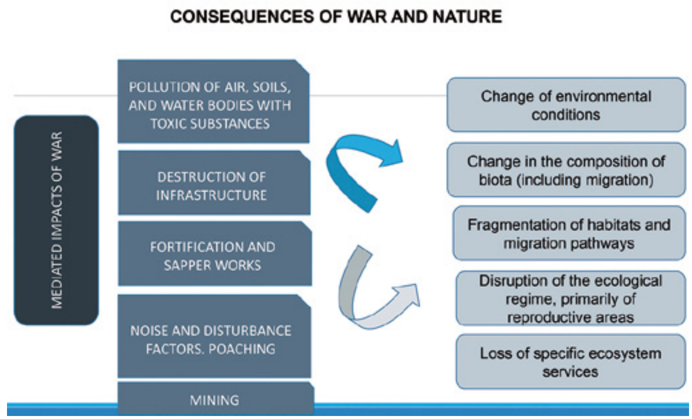

Fig. 4: Effects of war and nature © Presentation Lesia Zub

Fig. 5, 6: Military trenches were dug in the ›Kreideflora‹ reserve, a botanically unique area. Plants that only grow on chalk soils thrive here. © Presentation Lesia Zub

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down. This nature park was created to preserve and protect this unique ecosystem, and with its loss, its ecological, scientific, and health potential has also disappeared.
- A double ecological disaster occurred in the nature reserve on the Black Sea. First, the birch forests were damaged by flooding, and later they fell victim to fires.
- Breach of the Kakhovka Dam: entire habitats were washed away, including the nesting grounds of numerous bird species.
- According to official data, 160,000 birds and over 20,000 wild animals are at risk of death. The Ministry of Environment estimates the losses from wildlife mortality at nearly 146 billion hryvnias.
- A significant frog population has been wiped out, as well as the largest known colony of protected turtles.
- In Kinburnska Kosa, a peninsula in Mykolaiv Oblast that is home to more than 4,700 animal species—132 of them on Ukraine's Red List—entire habitats have been destroyed. While some species, such as tulips, may recover thanks to underground bulbs, many insects and small animals have lost their habitat.
- The largest orchid field in Europe has fallen victim to the flames. (Fig. 2)

The impacts on soil, air, and water are profound. Many soils are contaminated with explosives, heavy metals, or fuels. In some regions, natural bays were filled in by occupying forces, massively altering hydrological conditions.

The Ramsar Convention of 1971 is an international treaty for the protection of wetlands of international importance that meet the ecological criteria of the agreement (e.g., important for migratory birds, biodiversity, water balance). Ukraine has been a contracting party to the Ramsar Convention since 1991. Once a country officially designates a wetland, and it is included in the international list, that area is called a Ramsar site. Currently, a total of 50 Ramsar sites are registered in Ukraine, covering about 802,604 hectares.

- The Ramsar site Karkinytska and Dzharylhach Bays hosted one of the largest uninhabited islands in Europe, Dzharylhach, today, its wildlife and plant life are severely disturbed.
- In the Ramsar site on the Black Sea coast, Yahorlytska Bay, military fortifications were built—in one of the least disturbed wetlands of the region. As a result, rare steppe ecosystems, nesting grounds, and migration routes have been destroyed. (Fig. 5, 6)
- The Ramsar site Eastern Syvash is an important breeding and resting area for waterbirds. Due to military activities, communication between animal populations has been disrupted, and many habitats have become completely unusable. (Fig. 7–10)
- In the Kreidova Flora reserve—a botanically unique area—trenches were dug. This is home to plants that occur exclusively on chalk soils and often can only survive there.
- The Ramsar site Eastern Syvash, an important breeding and resting area for waterbirds. Due to military activities, communication between animal populations has been disrupted, and many habitats have become completely unusable. (Fig. 12,13)

The omnipresent danger of mines

- Over 80,000 square kilometers of Ukrainian territory are currently considered mined. Even in regions that were not directly battle zones, ecosystems have been destroyed. Tourism and traditional agriculture are no longer possible in many areas.
- The ecological consequences are also evident in the soil: explosions, destroyed vehicles, contaminated fuel, and ammunition have left behind a toxic mixture. This is now the reality in the south and east of Ukraine.

How long will demine take?

Basis of calculation: one single day of war requires one month of demining. By July 2024, the Russian war of aggression had already lasted almost two and a half

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Fig. 7–10: Black Sea Nature Reserve, Ramsar site »Yagorlytska Bay«, explosion near Tendrovskaya © Presentation Lesia Zub

Fig. 11: Warships disrupt the sense of orientation of dead dolphins on the coasts of Ukraine, Bulgaria, Romania and Türkiye © Presentation Lesia Zub

Figs. 12, 13: Thousands of water birds once lived here, including the pink pelican. Comparison photos show changes or the complete disappearance of the nesting sites. © Presentation Lesia Zub years; one can only imagine how many decades it will take to make Ukraine safe and ecologically functional again. **Today, Ukraine is the most heavily mined country in the world. And, similar to Germany, it is still dealing with clearing mines from World War II.**

Since the beginning of the war, more and more dead dolphins have been washed ashore on the coasts of Ukraine, Bulgaria, Romania, and Turkey, presumably as a result of sound waves from warships, which disrupt the animals' navigation systems. (Fig. 11)

Many of the most severely affected areas are currently inaccessible to scientists. It is not possible to provide a well-founded assessment or even a prognosis of the long-term consequences. What measures will be necessary remains unclear, as long as the war continues.

Ecocide
Experts now describe the ongoing ecological damage with a clear term: ecocide. This refers to the deliberate destruction of the environment — an attack on nature itself, carrying the potential for ecological catastrophe. Here, nature is not only a victim but is being turned into a weapon.

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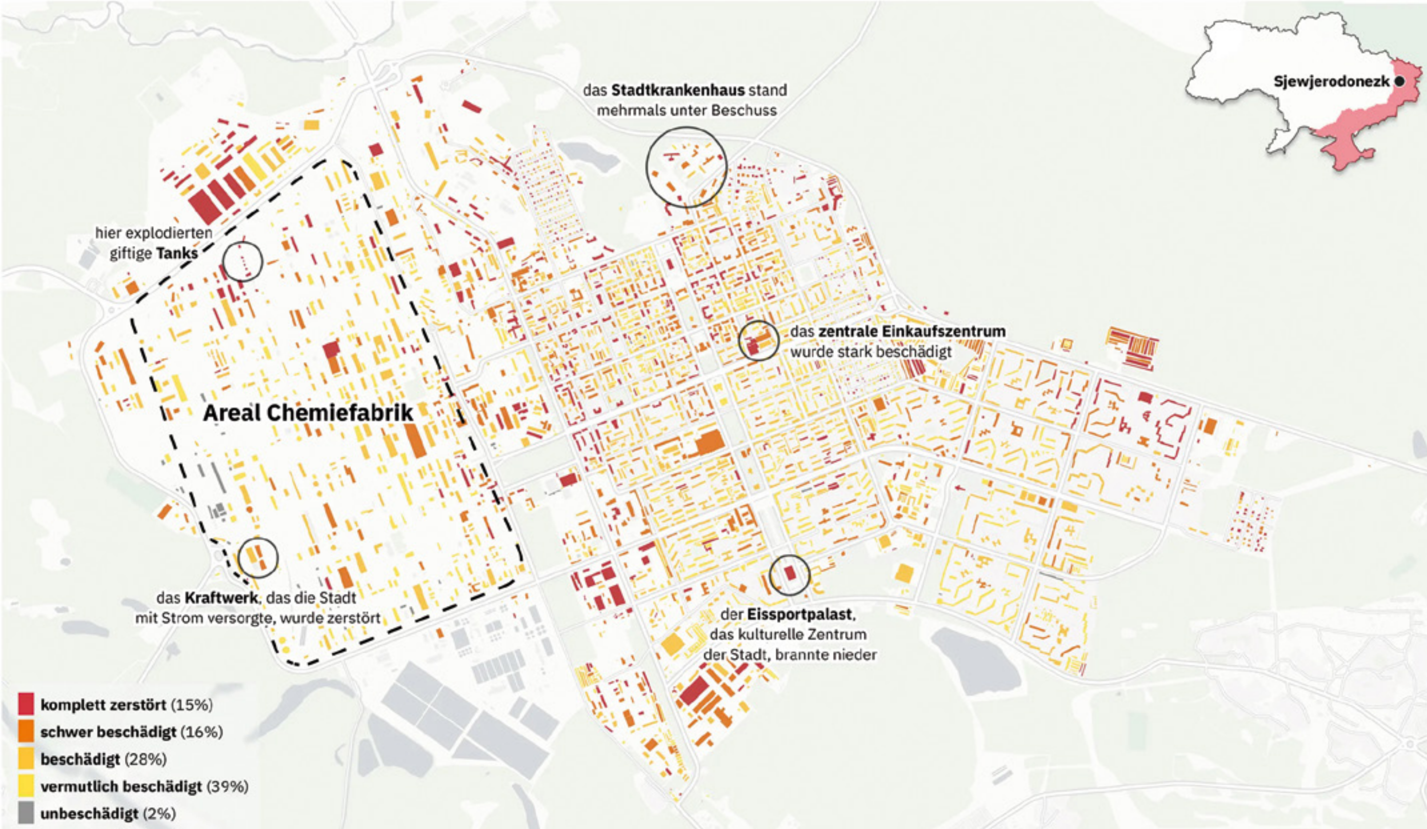

Fig. 14: Damage map of Severodonetsk, February 2024 (Data & Analysis: Mapping Ukraine/ETH Zurich; Base map: OpenStreetMap and CARTO © Tages-Anzeiger 4.4.2024)

Jonathan Banz, Basil Roth – Mapping Ukraine

Jonathan Banz, artist, architect, and surveying engineer, guest professor of construction surveying at the Faculty of Architecture at Munich University of Applied Sciences, member of the group Mapping Ukraine as well as the Swiss Network with Ukraine at ETH Zurich.

Basil Roth, project manager in humanitarian and social impact projects, active in film production, member of the group Mapping Ukraine and managing director of the Swiss Network with Ukraine.

Russia's full-scale invasion of Ukraine has caused significant damage to civilian infrastructure—hundreds of thousands of buildings have been affected, and reconstruction costs are estimated at over 500 billion US dollars. Although technologies such as 3D reality capture and mobile devices make it possible to document war damage in detail, much of the resulting data remains fragmented and unverified. Mapping Ukraine was launched in 2022 at ETH Zurich with the aim of building a verified, geo-structured database on the war's impact on Ukraine's civilian infrastructure. Mapping Ukraine integrates data from wartime and pre-war contexts from various sources to support damage assessment, compensation, and reconstruction.

Needs and Rationale

A reliable quantification of the damage and destruction to buildings, infrastructure, and land as a result of the war is essential for planning and managing reconstruction, setting priorities for recovery, processing compensation claims, and enabling stakeholder participation. Changes over time must be continuously recorded and assessed until reconstruction is complete, in order to ensure transparency and provide a clear overall picture.

Digital tools are indispensable for this!

- Quality-assured and automated
- With an appropriate classification of damages
- At all levels—from national or regional down to individual land parcels (cadastre)
- With sufficiently high temporal resolution to track processes of destruction and to distinguish intact or already reconstructed structures.

Early examples—such as Mapping Ukraine's own rapid damage maps, used by the Tages-Anzeiger (see Fig. 14), as well as related initiatives published in the New York Times—demonstrate the potential of such systems. However, these remain largely experimental. The tools often rely on single data types, require manual validation, and lack comprehensive quality assurance. In addition, they generally do not include a systematic integration of participatory or citizen-provided verifications. Mapping Ukraine seeks to close this gap.

- **Project Description**

The scientific and organizational foundations of the digital platform have been established. The alpha version was released in 2024 and introduced key functions for documenting property losses, supporting resource-efficient reconstruction, and processing compensation claims. An advisory network of experts and organizations in geodata, urban planning, and data science has been established. Initial pilot applications have been carried out, providing valuable insights into the versatility and practical uses of the platform.

The central technical objective of Mapping Ukraine is, as mentioned, the development, training, and testing of AI-based algorithms that can detect and classify damages, assess the quality of input data, and visualize results.

These tools are embedded in a modular workflow within the Mapping Ukraine GIS platform. The focus is on developing and testing automated methods for capturing detailed damage information over time and space, using:

- Radar satellite data (low resolution, regional/global coverage, independent of weather and daylight; provides large-scale baseline information)
- Multispectral satellite imagery (medium resolution, regional/global daylight coverage, with cloud-related data gaps; provides contextual information and supports quality control)
- Video and photographic material provided by citizens or collected from open platforms (high-resolution local data at specific points)
- Citizen-provided information, such as labels or training data (multimodal local data for validation, as training data, and for large-scale analysis)
- Baseline data, such as large-scale maps, digital or digitized 2D and 3D models (medium- to high-resolution pre-war data; used for contextualization, visualization, and plausibility checks)
- Curated accessible databases, such as ACLED and Bellingcat (highly localized data points; provide context and support plausibility checks).

A central area of research is automated image analysis through a three-step process:

- Geolocation of images using embedded metadata
- Identification of buildings in the field of view by combining metadata with cartographic data
- Application of a specially trained AI model to detect visible damage.

This method increases the reliability of damage assessment, as it can be cross-checked with other sources such as satellite imagery or compensation claims. (Fig. 15)

Fig. 15: Prototype dashboard of the Rapid Damage Mapping Tool, showing damage estimates for a region in Mariupol and visualization of the Sentinel-1 time series.
(Source: O. Dietrich et al. 2025, ETH Zürich); https://arxiv.org/pdf/2406.02506

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Next Steps

The next project phase focuses on developing AI-supported tools for automated damage detection, quality assessment, and visualization at different scales. By integrating satellite imagery, citizen-generated media, baseline data, and conflict reports, a modular workflow within the Mapping Ukraine GIS system will be created.

This system enables scalable, participatory, and evidence-based validation of damage reports. It supports reconstruction planning in Ukraine and provides a transferable model for post-crisis recovery worldwide. (Fig. 16)

Mapping Ukraine operates at the intersection of science and civil society. The project was initiated at ETH Zurich and is part of the **Swiss Network with Ukraine.**

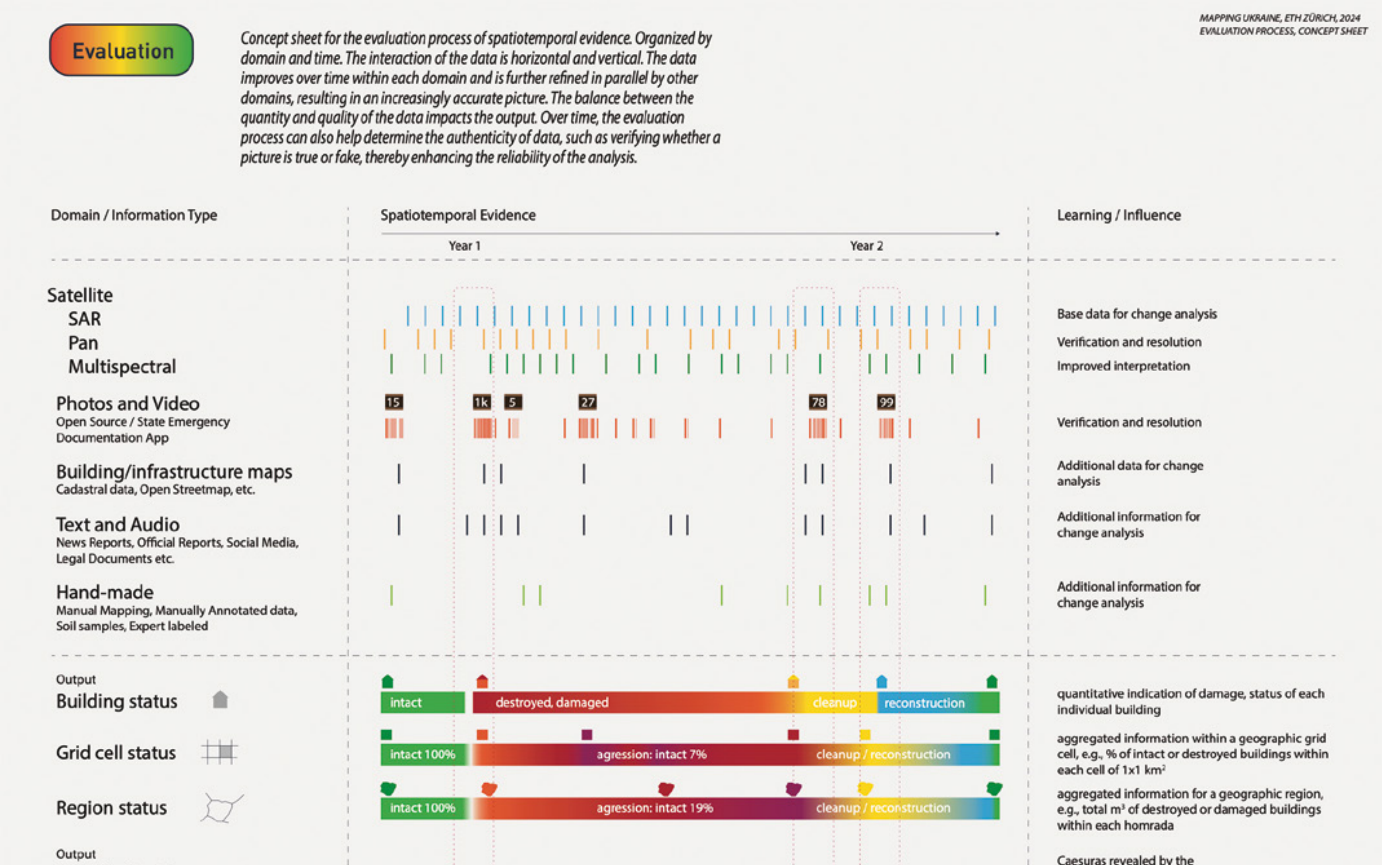

Fig. 16: Spatiotemporal evidence of damage. Information is extracted from diverse data sources using hand-crafted algorithms and machine learning. New data, covering the same buildings and areas from different perspectives, with different sensors and additional information, become available over time. This enables comparisons, reduces uncertainties, and allows the creation of time series. The automatically extracted information is thus continuously updated. © Jonathan Banz, Mapping Ukraine / ETH Zurich

Fig. 17

Fig. 18

August 10, 2022 – temporary dismantling

September 8, 2022 – Concreting posts and baseplates

October 27, 2022 – Reconstruction of walls and windows

Fig. 19

Fig. 20

Fig. 21

Fig. 22

Images: destroyed residential buildings as a result of military action © Presentation by Prof. Gennadiy Farenyuk

Prof. Gennadiy Farenyuk – On the Building Material, Structural, and Ecological Aspects of Reconstructing Residential Buildings Destroyed as a Result of Military Impact

Subject of the study
Characteristics of the extraction and use of building materials and products, with special consideration of recycling technologies for construction waste of military origin, as well as the assessment and development of advanced solutions for the restoration of damaged building structures. (Fig. 17, 18)

Destruction and initial reconstruction measures
As a result of Russia's military aggression, more than 180,000 single-family houses in Ukraine have been damaged or destroyed, as well as about 28,000 multifamily buildings.

The first task was to inspect the buildings and assess their structural serviceability. Using mathematical models, load assumptions were calculated, physical properties analysed, and conclusions drawn whether reconstruction was possible and reasonable.

Example: This multifamily building was hit by a missile. Based on technical criteria, we developed rehabilitation strategies that allowed residents to return to their apartments. On the 17th floor, three apartments were destroyed; we dismantled the ten floors above and rebuilt them according to the original architectural design. (Fig. 19)

Methodology for assessing building condition and reconstruction practice
Up to now (July 2024), around 100 buildings have been repaired in this way during the course of the war — each with project-specific solutions. In total, we have inspected 600–800 multi-storey residential buildings. Another example is a five-storey building in the city of Uman, where an entire structural unit was destroyed. By using prefabricated panels, the building was gradually reconstructed. By July, the reconstruction had reached seven storeys. This approach made it possible to continue using the undamaged part of the building.

Need for new assessment approaches for building structures
Our findings clearly show that it is necessary to rethink the assessment methods for the physical and mechanical properties of damaged building materials. The war in Ukraine provides unprecedented data on the structural effects of explosions and fires on construction materials. A systematic investigation of these changes — for example in steel, concrete, brick, insulation materials, forms the basis for new technical standards in construction.

The goal is to be able to precisely evaluate the remaining load-bearing capacity and the changes in material properties caused by thermal and mechanical impacts, even when no visible damage is present. (Fig. 20)

Evaluation of current structural analysis methods and new risk approaches
The assessment and further development of existing methods for structural analysis is a central field of work. In addition to classical load assumptions, new influencing factors must be considered: among them seismic-explosive loads, as occur with underground detonations, as well as impact loads. The focus is on developing calculation methods to maintain the structural integrity of damaged structures, including the assessment and prevention of progressive collapse processes. These approaches are crucial for risk assessment and the prioritization of reconstruction measures. (Abb. 21, 22)

Recycling strategies for war-related construction debris
In the reuse of construction debris, there are fundamental differences between controlled demolition and destruction caused by war. While in planned demolitions the mineral composition and grain size distribution can be controlled, this uniformity is absent in rubble resulting from war damage.

Criteria for assessing reusability

- mineral composition
- grain size distribution
- potential toxicity due to fires, asbestos, munitions impact, fire accelerants
- asbestos hazard

In single-family houses built before the year 2000, asbestos-containing roofing material was very often used. The contaminated composition of the debris makes secondary reuse significantly more difficult. The estimated volume is about 100 million cubic meters of rubble in Ukraine alone.

Fig. 23, 24: National Museums in Berlin, Museum of Prehistory and Early History © Karl Instinsky

Fig. 25–28: Institute for Architecture-Related Art, TU Braunschweig, Seminar: Inheritances, 2021 © Stella Flatten

Technological and regulatory requirements for recycling processes

Modern recycling methods must be specifically adapted to the conditions of military conflict. The use of technologies for processing debris into new building products requires:

- classification of rubble by type and level of contamination
- technological processing according to its reusability
- the development of binding regulations that
- define technological procedures and safety standards for recycled building materials.

Currently, both national and EU-compliant regulations for handling construction waste exist in Ukraine and are applied in parallel.

Assessment of the environmental compatibility of building materials

The processing and reuse of construction debris must follow clear regulations. In Ukraine, both national regulations and new European standards introduced over the past two years are currently in force in parallel.

Another important aspect is the assessment of the environmental friendliness of building materials. It is not enough to rely solely on organic materials such as reed or straw. Environmental compatibility must be evaluated comprehensively. In Ukraine, the standard »Guidelines for the Energy Labeling of Materials and Products for Building Insulation« was introduced in 2016. These guidelines make it possible to systematically classify the ecological properties of building materials, based on transparent and verifiable calculations.

Stella Flatten – On Ruins, Debris and Clearing of Rubble

Stella Flatten dedicates her work to the appropriation and legibility of space. At the center of her research-oriented practice are questions about the visibility of historical traces in the built environment and “digging” as an artistic method within social and activist contexts. She is particularly interested in how war trauma has left marks on our present-day surroundings, and how the material remnants of such violence have been and continue to be dealt with. (Fig. 23, 24)

Clearing of rubble after the Second World War
After the war, an estimated 400 to 500 million cubic meters of rubble lay across Germany, with around 75 million in Berlin alone. The attempt to organize the clean-up through voluntary helpers failed.

- Clearing rubble was at times presented as “community service” — for example, through regular Saturday shifts for women or by requiring university applicants to complete 40 hours of rubble clearing and provide proof of hours worked in order to enroll.
- Real professionalization began when so-called rubble clearing companies were founded, which were paid a flat rate per square meter.

How the material remnants of war long remained visible in cities, in the form of landscapes of ruins, and what role they play in collective memory.

»The precarious balance between the still visible determination of form and the not yet complete dissolution of form predestines ruins to become the silent sign language of history» — Hartmut Böhme.

What is crucial is how memories and traumas remain permanently present and can be carried forward architecturally and continuously processed in the future. The artistic question is: to what extent can build testimonies of violence not only be removed or built over, but instead be kept open for future design and interpretation?

Time, Flatten argues, is often ignored in urban planning and heritage conservation. Planning projects the supposed present of the future from the standpoint of the present. The future is fixed, often without integrating the future users of these built realities or leaving space for them. Future generations are confronted with faits accomplis. Existing buildings and urban images are restored and idealized to imagined original states in order to preserve them.

The Swiss sociologist Lucius Burckhardt summarized this in his 1977 article Building — a process without obligations to monuments: »Each generation creates its own seemingly timeless past by destroying the past of its fathers.«

In this sense, the coexistence of temporal traces disappears with each renewed architectural annulment of time.

The long-term consequences of wars on bodies, cities, and narratives continue across generations, through epigenetic imprinting, through stories, through the things once called »beautiful,« and the things needed for a »good life again.«

What is the architecture we want to build for the long term? How do we move away from concrete? How can we truly create sustainability and aesthetic value?

Digging as a method
Flatten’s doctoral project is titled »The added value of a new methodological approach to an everyday practice.« Here, she understands digging not only literally but also as a metaphorical approach to buried memories.

Her artistic practice aims for an active, bodily engagement with memory — not in the sense of creating more monuments, but as a process-oriented appropriation and collective action.

In the spirit of the philosopher Walter Benjamin: »Anyone who seeks to approach their own buried past must behave like a person who digs.« And the call of the writer Sven Lindqvist: »Dig where you stand!« (Fig. 25–28)

At the Institute for Art in Architecture at TU Braunschweig, Flatten developed, together with students and colleagues, a participatory excavation dealing with the institute’s past during National Socialism. Together, they first »dug« through the institute’s archives, old construction plans, and historical descriptions before carrying out the actual physical excavation on site.

The institute’s building, located remotely in a wooded area, served during the Second World War as a site of »research important to the war effort« for TU Braunschweig. Traces and construction elements of a ballistic testing facility were found there, where, in addition to Polish, Ukrainian forced laborers had to test the effects of weapons (grena-

Fig. 29: Radical Playgrounds - From Competition to Collaboration, Berliner Festspiele, Gropius Bau Berlin, 2025

Fig. 30: In the image, a red ellipse marks the area that Flatten and her team surveyed and where the excavation took place. This area was located in the historic cellars where archaeological finds, including those from Troy, were once stored. © Staatliche Museen zu Berlin, Museum für Vor- und Frühgeschichte, Photo: Karl Instinsky

Fig. 31: North facade of the Museum of Ethnology during its demolition in 1960/61. © Staatliche Museen zu Berlin, Museum für Vor- und Frühgeschichte, Photo: Karl Instinsky

des, bazookas, explosive charges) on concrete. The traces of these tests, now overgrown, lie like silent memorials in the forest. No one knows what to do with them. The collective, physical digging by the students, roughly the same age as the forced laborers once were, became a striking, almost performative moment of historical confrontation, making the past tangible and directly felt.

Radical Playground

In collaboration with the artist collective School of Mutants from Dakar, Flatten discovered during her research for the art parlours »Radical Playgrounds« that today's car park next to the present-day Gropius Bau in Berlin was built directly over the vaults of the First Royal Museum of Ethnology, without this being visible in the cityscape or public awareness any more. A memorial plaque, placed in a remote corner, barely indicates the historical significance of the site.

In a collective process, the participants began to unseal the ground: the cobblestones of the car park were lifted to literally look beneath the surface — down to where history had disappeared under asphalt. (Fig. 30, 31)

In 1985, excavations took place on the opposite side of the Gropius Bau, at the site where Berlin had allowed green spaces to grow over the former torture cellars of the Gestapo. Some of the participants of the then action »1933–1945 Nachgegraben« were invited by Flatten to take part again and to speak about their motivation at the time. Together, they dug once more, this time with a focus on Berlin's colonial legacy.

The action attracted great attention. In its participatory and activist character lay a central message: it is not about waiting for institutions to create spaces for historical engagement, rather, it is about opening the ground itself to make visible what lies hidden beneath the surface.

For Flatten, this approach represents an artistic methodology characterized by openness, processuality, and the use of the body itself. She understands it as a collective, performative practice in which the outcome cannot be predetermined. Digging becomes the elementary, accessible act that enables direct participation for everyone involved. It opens an approach to the ground, understood as an archive that preserves traces of human and non-human life and makes them tangible through physical action.

All remains found in the ground, primarily rubble from the Second World War, originally used to seal the site, were presented during the action in a walkable access tunnel, symbolically serving as a passageway to the excavation area. Such a temporary archive is an open, unfinished memory, inviting visitors to engage directly with the unearthed materials. Some of the objects were taken into the museum's collection, including shards and fragments of clay bowls from the Middle Ages or from Southeast Asia. The remaining finds were placed in a box and reburied at the end of the exhibition as a kind of time capsule, not as an act of suppression, but as a conscious decision about how to engage with history. Afterwards, the car park was sealed again. Yet the knowledge of what lies beneath remains, and continues to shape the perception of this place.

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»Millions of children are living in constant fear, many spending up to six hours a day in basements while air raid sirens wail,« said Russell. »Without continued and increased support for these children, the psychological wounds of this war will echo for generations« UNICEF+

© HOPE HOME • НАДІЯ Material Show, Kyiv 2025, Natalia Azarkina

War Trauma and Healing Architecture

The loss of one’s own flat or house, which can be understood as the loss of a »third skin« — whether through displacement, war, natural disasters, or other forced circumstances, means profound uprooting. Traumas arising from such experiences manifest in insecurity, alienation, and helplessness, wounds that affect both body and soul.

War veterans carry not only physical injuries but also psychological ones: insomnia, anxiety, inner restlessness, memories that will not fade. Physical and emotional wounds are often closely intertwined, reinforcing each other and making the return to a stable daily life a challenge.

The psychological traumas suffered by children, women, and families in Ukraine due to loss and destruction are equally severe and far-reaching. The impact of the war on these groups is alarming.

Traumatic experiences lead to a severe impairment or even a complete destruction of the feeling of safety and trust in other people. Without being consciously aware of it, we rely in our everyday life on the assumption that society and the world form a symbolic net that holds us.

Erik Erikson described this state as »basic trust«. He explained how the experiences of the first year of life shape one's attitude toward oneself and the world. The many interactions with primary caregivers, especially their positively resonant reflections and affirmations, give the child a sense of the fundamental reliability of the world, both regarding the trustworthiness of others and the dependability of the self.

When people are traumatized, we are confronted with the fact that this very basic trust in a safe world, which had become our »second nature«, is destroyed and permanently deprived of its quasi-naturalness.

Trauma creates an irreversible breach of trust in a predictable and safe environment. This breach does not heal. In this sense, trauma is a »social wound« (Morris) with existential consequences. Of course, the severity of the trauma plays a role here. But there is always an unconscious feeling of having been abandoned by the protective power of parents or by all benevolent forces. It is one of the deepest dimensions of existential experience activated by trauma, preventing the traumatized person from feeling at home in the world.

Werner Bohleber: https://traumaresearch.yale.edu/werner-bohleber

The number of children suffering severe stress due to the effects of war is rising rapidly. According to UNICEF, at least 2,406 children have been killed or injured since the start of the war, and millions are struggling with its psychological consequences. A study estimates that nearly 70 percent of surveyed children and adolescents in Ukraine show symptoms of post-traumatic stress disorder (PTSD), with rates among preschool children reaching up to 95 percent. https://capmh.biomedcentral.com

Women under psychological strain and violence

Women in Ukraine are particularly affected by the psychological impact of the war. UN Women reports that 75 percent of women regularly suffer from depression, 62 percent experience sleep problems, and 65 percent suffer from nightmares. In addition, violence against women has risen alarmingly. In the first half of 2023, cases of domestic violence increased by 51 percent compared to the previous year. UN Women Wikipedia

Families under strain from loss and destruction

More than 2.5 million destroyed homes and the displacement of millions of people have had profound effects on family structures. Many families are forced to live in temporary shelters, which creates additional psychological stress. Constant insecurity and the loss of home and safety intensify feelings of uprooting and loss.

Urgency of support

The psychological traumas caused by the war's impact on children, women, and families are profound and long-lasting. It is urgently necessary to provide support to these groups to alleviate psychological burdens and strengthen resilience. We can speak here of transgenerational trauma that may manifest symptomatically across many subsequent generations if people are not met with trauma-sensitive, empathetic initial care.

Healing architecture

Approaches such as healing architecture, where people create spaces with their own hands using natural building materials, can contribute to psychological recovery. Such projects not only foster a sense of self-efficacy, but also promote social integration and community belonging.

The combination of physical activity, such as building, with psychological healing addresses the profound traumas of war and helps pave the way toward a more stable and healthy society.

(Re)building with one's own hands what has been destroyed can strongly support rehabilitation. The physical act of construction, the sensory contact with wool, wood, and clay, the conscious creation of spaces, all of this has a strengthening effect on the body and a stabilizing effect on the mind. Architecture can support healing processes by restoring spaces with light, air, and touch.

Every roof laid by one's own hands, every wall erected, every surface shaped, every color mixed can become a symbol of one's own agency, a mirror of the inner work on trauma and wounds, a sign of the possibility of creating a new home after loss. To stay within the metaphor: in the act of working with the material, part of the trauma is absorbed and processed.

Yuliia Leites – Psychoanalysis, Psychedelics, and Collective Healing

Yuliia Leites, a psychoanalytic psychotherapist based in Kyiv, works at the intersection of trauma, war, and altered states of consciousness. Her clinical approach combines traditional psychoanalysis with innovative methods of trauma treatment, including psychedelic-assisted therapy. Since 2020, she has been working with vulnerable populations, including veterans, adolescents struggling with substance use, and survivors of domestic violence.

In early 2023, she began additionally supporting Ukrainian soldiers by offering free therapy sessions via social media. She quickly received dozens of requests and ultimately took on two clients. One of them, a cultural worker drafted as a soldier, continues his therapeutic journey amid missions at the front. The other, a military medic, was killed after several months of intensive emotional work while deployed. These therapeutic bonds are fragile, yet they

Fig. 1–6: Subjects © Yuliia Leites

Post-traumatic stress disorder (PTSD) often develops after a traumatic experience, such as an accident, natural disaster, or war event.

Complex post-traumatic stress disorder (CPTSD) arises from chronic, repeated traumatization. Causes include prolonged child abuse, domestic violence, imprisonment as a prisoner of war, or other situations in which one could not escape or protect oneself.

Figs. 7–10: Experiencing materials through touch © HOPE HOME • НАДІЯ Material Show, Kyiv 2025, Natalia Azarkina

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highlight the urgent need for trauma-specific psychological care in combat zones.

Leites also joined the Fenix Psychedelics Rehabilitation Center in Valencia, Spain, to support a unique group: two »defenders of Azovstal«, a soldier who survived captivity, and two mothers, one of whom lost her son in the bombing of the Olenivka prison. Through a week-long program combining MDMA (a substance that promotes openness, trust, and emotional connection) and psilocybin (a consciousness-expanding compound found in so-called »magic mushrooms«), participants experienced profound emotional release and reconnection. Yuliia Leites facilitated integrative individual and group sessions, witnessing how collective trauma could be softened through shared, community-based healing.

Yuliia Leites assumes that there is a very high number of people in Ukraine suffering from chronic traumatization. For many, it began in the 1990s after the collapse of the Soviet Union and continued in 2014 with the military actions in Crimea and Donbas. The current, ongoing Russian war of aggression affecting the entire country is, she says, the final, fatal blow that makes all past traumas almost unbearable.

She asks: In light of this, are we considering creating environments specifically tailored to fragile people? Do we truly understand the extent of their fragility, and what can serve as a healing and reconnecting experience?

Her working approach is a concept of healing that combines psychoanalysis, psychedelics, and collective experiences. She advocates for specially designed environments to support people with complex PTSD (CPTSD), where safety, sensory care, and community can foster recovery in ways that traditional settings cannot.

* Footnote: The term »defenders of Azovstal« refers to those Ukrainian soldiers who, in the spring of 2022, held the Azovstal steel plant in Mariupol, the vast industrial complex and last refuge of the city, for weeks against the Russian siege, becoming a symbol of Ukrainian resistance.

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Lena Grabowski – Healing Through Trauma-sensitive Design and Social Connectedness

Lena Grabowski — a psychotraumatology expert specializing in holistic mental health and child protection, based in Berlin. She works at the intersection of psychology, creative architecture, and humanitarian aid. With a background in art therapy and trauma treatment, she supports refugees and children affected by war, displacement, and complex emotional burdens.

Together with colleagues, Lena Grabowski has developed an educational concept for refugee centers (initial reception centers/accommodation) and first responder teams across Germany, training professionals in trauma-informed care and psychosocial support. Her focus areas include child protection, sequential traumatization, and transgenerational trauma processing.

Trauma literally means wound or injury and can result from war, displacement, and systemic neglect — emphasizing the importance of a stable, early environment for psychological recovery. Healing does not come from therapy alone but also from safe spaces, physical activity, relational care, and psychoeducation.

Within the framework of HOPE HOME • НАДІЯ, Lena Grabowski formulates the idea of healing architecture as an integrated method of trauma recovery. Her research addresses both the causes, from war to ecological disasters, and the symptoms, ranging from insomnia and hypervigilance to emotional numbness and disorientation.

Lena Grabowski is convinced that architecture can have a healing effect as a structured environment that reduces chaos and strengthens trust, routine, and social bonds. In this vision, healing is not only internal but also spatial, and recovery can be supported through shared building, communal cooking, and collective creative practices.

She is part of the integrative approach of HOPE HOME • НАДІЯ, where trauma therapy and psychosocial first aid for people living in or displaced from disaster and war zones play a key role

»A psychological trauma is an emotional injury caused by an extremely stressful or life-threatening event that overwhelms a person’s usual coping abilities. Typical consequences can include persistent anxiety, helplessness, inner hyperarousal, or the repeated re-experiencing of the situation.«

Deutsche Gesellschaft für Psychotraumatologie (DeGPT)

Post-traumatic stress disorder (PTSD)

Year	Number of people diagnosed with PTSD seeking help	Number of military personnel diagnosed with PTSD	Number of adults diagnosed with PTSD in conflict zones
2022	100.000	25 %	10 %
2023	120.000	above 28 %	12 %
2024	130.000	up to 30 %	5 %

Abb. 11: Statistik, Inna Obelets

Fig. 12–15: Experiencing materials through touch © HOPE HOME • НАДІЯ Material Show, Kyiv 2025, Natalia Azarkina

Central to this work is the theme of the loss of one's inner home — the feeling of being »broken« inside and having lost oneself, the sense of an inner refuge. War and displacement are inseparably linked with existential experiences and emotions: overwhelming situations, mortal fear, loss, destruction, helplessness, despair.

In trauma therapy, the fragments of the human psyche are approached with great care. The process is similar to the slow rebuilding of a country after a catastrophe. To stabilize a fragile, vulnerable psyche in a highly aroused, alarmed body, it is essential to create an »inner safe place« or »inner safe home« through imagination.

With children, Lena Grabowski builds small dens and huts; the focus is on visible and safe boundaries and the feeling of having one's own space, one's own home. She mainly works with tactile, sensory natural and artistic materials such as sheep's wool or humus, as well as with biographical writing and painting. Providing material and time for extended creative processes can play a crucial role in processing and integrating traumatic content.

At HOPE HOME • НАДІЯ, trauma therapy and trauma-sensitive psychosocial first aid for people in war zones are an integral part of the concept. The possibility of rebuilding a lost home with one's own hands and resources becomes deeply healing.

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Inna Obelets – First Psychological Aid for Mental Trauma

Inna Obelets — clinical psychologist and trauma therapist, originally from Kyiv, now lives and works in Rostock. Her work focuses on providing immediate psychological first aid for refugees, children, and survivors of war and torture. She offers psychological support and psychoeducation on-site throughout Germany.

In Ukraine, the issue of PTSD has become particularly relevant due to the military conflicts and other major events of recent years. According to studies by the Ukrainian Ministry of Health and various non-governmental organizations, the number of people suffering from PTSD in Ukraine increased significantly between 2022 and 2024.

It is estimated that about 15–20 percent of the population affected by hostilities suffer from PTSD. Among military personnel, this share is 30–35 percent. (Fig. 11)

With her experience in both the medical and social fields, Inna Obelets has supported hundreds of displaced Ukrainians in acute crisis situations. Her expertise lies in the rapid stabilization of people with post-traumatic stress disorder (PTSD). This includes creating a sense of safety, restoring basic needs such as food, warmth, and physical shelter, and building trust through attentive listening or nonverbal means such as drawing and building with children.

Obelets also emphasizes the importance of social reconnection and stabilization techniques such as grounding, breathing, and sensory regulation. Sensory regulation refers to the ability to perceive, process, and respond appropriately to sensory input. It is about managing stimuli from the environment — such as sounds, light, touch, smells, or movement — so that behavior and emotions can remain balanced.

For people who have lost their homes, healing begins with being seen and cared for. The range of support extends from immediate on-site crisis assistance to long-term help with resettlement. Throughout, the focus remains on understanding their trauma, preserving their dignity, and offering human closeness.

The primary goal of psychological first aid is to provide an immediate sense of safety and support in order to reduce the risk of developing chronic PTSD.

Fig. 16: Temporary accommodation of internally displaced persons (IDPs) in Western Ukraine © Anna Dobrova, CO-HATY

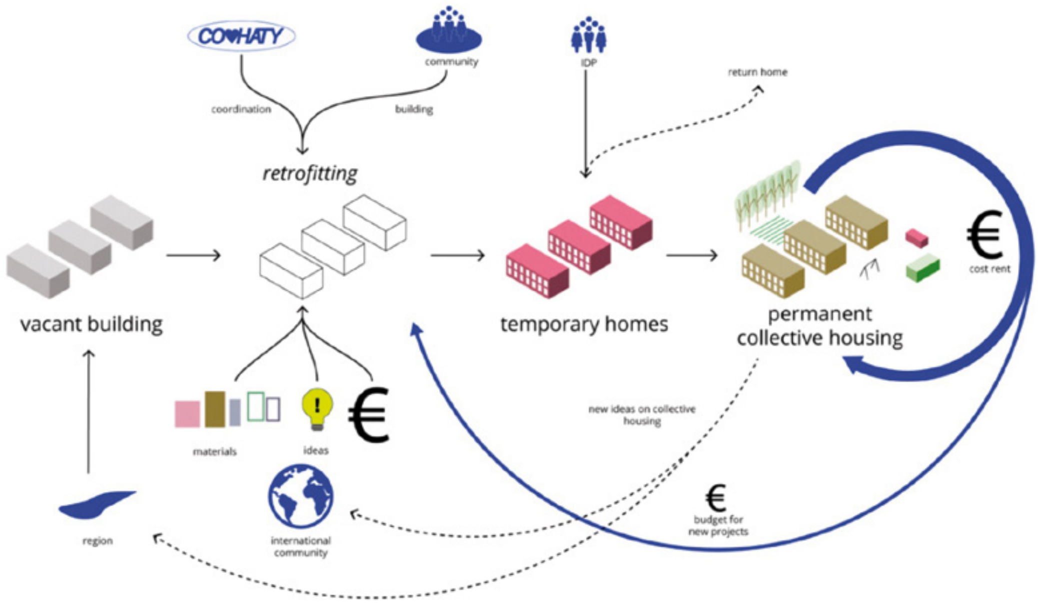

Fig. 17: Panorama of Ukraine »Healthy Neighborhood« © Anastasiya Ponomaryova, Thijs van Spaandonk, Mark Sagin, Maryna Savko, Milica Ozçelebi

Figs. 18–21: Projects with sustainable biomaterials and circular economy: Prototypes for durable housing with local energy solutions promote resilience © Anna Dobrova, CO-HATY

Anna Dobrova – From Architecture to Restoration. Social Housing as Collective Healing

Anna Dobrova — architect and co-founder of Metalab and the housing initiative CO-HATY. Her work focuses on sustainable reconstruction, circular use of materials, and trauma-informed architecture as a tool to rebuild lives and communities after displacement.

After the 2022 invasion, her organization shifted its focus from sustainable urban planning to the reconstruction of emergency housing through the CO-HATY initiative. In Ukrainian, haty means »houses« and cohaty means »to love«, displaced people are at the center of the planning and renovation process.

CO-HATY began by rapidly renovating an abandoned student dormitory to house displaced people. Since then, Dobrova's team has renovated six buildings and provided housing for more than 1,200 people. In doing so, they have created a model for participatory reconstruction based on urgency, community, and circular resource use. The design process focuses not only on shelter but also on dignity, self-determination, and therapeutic engagement.

Through hands-on volunteer work, shared meals, and participatory design, CO-HATY has become a place of social grounding and psychological resilience. Many volunteers were displaced themselves and now form the backbone of the program's leadership. Dobrova's approach links rebuilding with material agency — rebuilding for others while simultaneously rebuilding one's own sense of purpose.

She also collaborates with organizations experimenting with sustainable biomaterials such as kombucha-based leather and has begun to integrate reuse and circularity into current projects. Her team is now developing prototypes for longer-term housing with local energy solutions, aiming to achieve resilience through repair and re-rooting. (Fig. 15–21)

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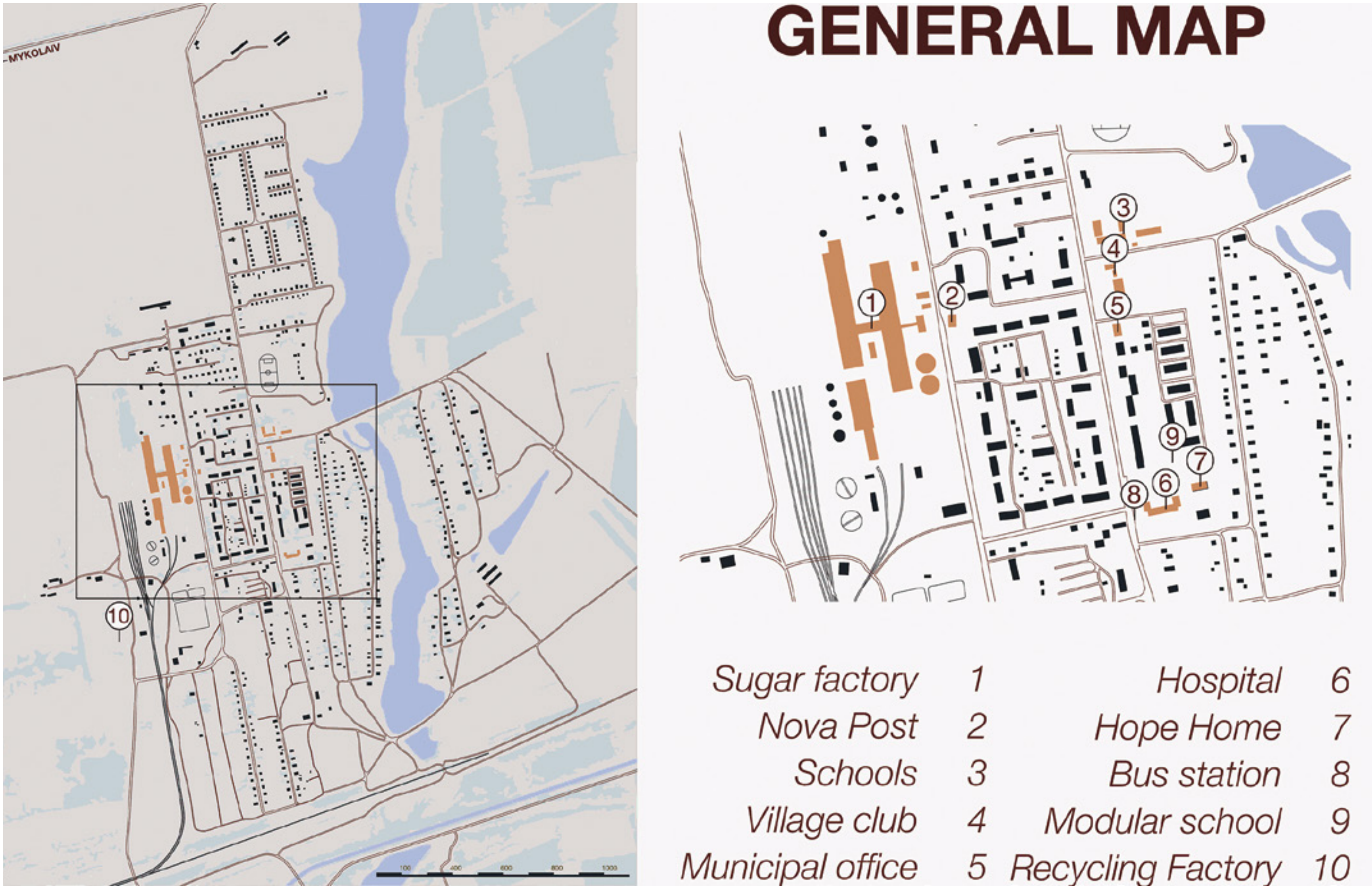

Fig. 1: Mapping Pervomaiske © www.nbl.berlin/projects/mapping-of-pervomaiske/

Building Hope in the Community of Pervomaisk

In the southern Mykolaiv region (Oblast) of Ukraine, not far from the Black Sea, lies the hromada of Pervomaisk — a rural community that counted nearly 10,000 inhabitants before the war. It consists of 11 small villages connected by farmland and simple roads, relying mainly on agriculture and local industry.

Since Russia's full-scale invasion in 2022, Pervomaisk has suffered severe destruction, displacement, and social fragmentation. The community has faced the destruction of its sugar beet factory, once the largest employer, as well as water shortages, ruined schools and homes, a lack of cultural and youth spaces, and damaged infrastructure, particularly due to the large amounts of war debris.

Listening and Understanding
In September 2024, Maksym Kashuba, Head of the Military Administration of the Mykolaiv District, and HOPE HOME • НАДІЯ signed a cooperation agreement in the presence of community members to assess the region's needs and explore how an ecological, community-oriented reconstruction could support the village of Pervomaiske.

Local authorities expressed their willingness to make Pervomaiske a pilot project for ecological construction using renewable and recycled materials, a project not only focused on sustainable rebuilding, but on fostering a broader ecological transformation.

This agreement marks the beginning of HOPE HOME • НАДІЯ's work, which started in late 2024 in Pervomaiske. The initiative focuses on ecological reconstruction and on empowering the local population, guided by the conviction that true reconstruction must begin with the people themselves.

From Vision to Implementation
Since the 2025 federal budget in Germany did not allocate any public funds by September 2025, leaving even already launched projects without continuation, HOPE HOME • НАДІЯ initiated a crowdfunding campaign. The goal was modest yet symbolic: to begin repairing buildings using natural materials such as hemp, straw, and clay — to demonstrate that reconstruction without concrete is not only possible, but also sustainable and cost-effective.

The first objective was to transform part of the bombed community and administrative center into a youth space. The absence of a safe meeting place for the roughly 300 young people who had stayed or returned posed a tangible threat to the community's future.

Thanks to donations, we were able to procure the necessary materials and mobilize mentors and partners from our network before the onset of winter 2024–25. Our approach is co-creation: residents worked side by side with the HOPE HOME • НАДІЯ team and expert builders.

Together, we began restoring the damaged building using a hemp-lime mixture. This hands-on collaboration became an important step, not only in rebuilding walls, but in helping people scarred by war regain agency, trust in others, and a renewed sense of hope.

• Mapping Pervomaiske
The Natural Building Lab at TU Berlin and HOPE HOME • НАДІЯ, together with students, are creating a comprehensive spatial documentation of the war-affected village.

Because only limited reliable geodata were available, the team developed new 2D maps from satellite imagery, produced 3D building typologies, and classified zones ranging from residential to industrial and public buildings. In close cooperation with local residents, the extent of the damage was assessed.

This collective cartographic effort has created a valuable visual and analytical foundation for future ecological reconstruction, and has strengthened trust in the work of HOPE HOME • НАДІЯ.

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