



# Material hierarchies

Article I, WP3: SUSTAINORDIC  
– Sustainable Construction  
Materials and Architecture



Nordic  
Innovation

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# Preface

This article is a part of the Nordic Sustainable Construction programme initiated by the Nordic Ministers of Construction and Housing and funded by Nordic Innovation. The programme contributes to the Nordic Vision 2030 by supporting the Nordics in becoming the leading region in sustainable and competitive construction and housing with minimised environmental and climate impact.

The programme supports the green transition of the Nordic construction sector by creating and sharing new knowledge, initiating debates in the sector, creating networks, workshops and best practice cases, and facilitating Nordic harmonisation of regulation for buildings' climate impact.

## **The programme runs from 2021–2024 and consists of the following focus areas:**

- Work package 1 – Nordic Harmonisation of Life Cycle Assessment
- Work package 2 – Circular Business Models and Procurement
- Work package 3 – Sustainable Construction Materials and Architecture
- Work package 4 – Emission-free Construction Sites
- Work package 5 – Programme Secretariat and Capacity-Building Activities for Increased Reuse of Construction Materials

This article is a result of Work package 3, SUSTAINORDIC. The article is written by Malin Zimm with research by Pernille Martiny Modvig.

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# Material hierarchies

## Shifting towards sustainable practices and material in construction

### Introduction

Architecture is, in essence, an artful pile of material. Throughout history, this material has been a very valuable asset. So valuable that no building would be standing unused for long. Stones for walls, entire columns, roof tiles, floor tiles, windows and doors of course – everything can be dismantled and placed in new contexts. The term for building parts, removed and inserted in new buildings, is spolia, left-overs. We might have put some distance between our fossil-era-fuelled building industry and this building tradition, but in fact, building material is as valuable today as it was in ancient times. We just don't respect it as much, and we find it easier to replace it with newly sourced material, even though we are surrounded by possibilities.

Something in our minds has shifted during the last century. From the turn of the 19<sup>th</sup> century, we have witnessed two world wars with immense destruction of urban areas, and the subsequent need for rebuilding. Combined with social engineering and standard improvements of housing, we have provided ever growing urban populations with new housing, and a growing state and municipality with public services in new buildings, then adding infrastructure for growth, social, industrial and economical mobility. In the last century we have come to accept, even celebrate, the immense act of entropy that is the demolition of a building. What took years to build takes days to tear down. In a cloud of dust, the material is painstakingly removed, truckload after truckload, to become landfill.

Maybe we lost respect of the work involved in building, operating diesel-powered machines and cranes to do the hard work, instead of men lifting half their body weight in bricks, walking ten floors up, as when the Stockholm City Hall was constructed in the 1920's. The demand for new buildings has spiralled under the influence of global markets seeking investments, while rules and legislation systems are lagging. Under dire climate circumstances, we need to remember that the model of the building industry during the last century is an exception in history. Buildings are in our time either over-valued or under-valued. If they were assessed right where they are – standing, functional, maybe in need of an update, but far from ready for landfill – we would not fail to see the structural value that they represent, being artfully layered material.



Photo: Ditte Isager

# No change without reach – the voice of the activist and opinion shaper

**Signe Wenneberg, climate activist, speaker, author and journalist, Denmark**

Signe Wenneberg is well known to the Danish audience, often featured in public debates, giving lectures around the country and serving a wide audience of Instagram followers. Wenneberg is keeping a close eye on national heritage, architecture and climate policy, summoning fellow climate ambassadors as well as people who just feel sad to see old beautiful houses being demolished and replaced by uninspired constructions. Covering climate issues, cultural heritage and democracy in planning, she communicates by examples and with an educational and straightforward approach. Signe Wenneberg also walks the talk as a construction pioneer:

– During the last three years I have rebuilt two national heritage houses, the last one is where I have my office and home called @studiehuset in Instagram. I have taken the opportunity to show my readers how they can renew an old house in a sustainable manner so we will prolong the buildings life with a century or more. Everyone can do their bit – and I think people sense that, when they read my stories, as I am not a trained builder nor an architect. Before that I built the world's first FSC-certified wooden house on pillars: A project that was presented on prime-time TV. In terms of construction, the summer house was as sustainable as it could possibly be, with locally sources material, recycled windows and doors and only FSC certified wood and biobased insulation. That house for sure got a lot of attention! Called #signessustainablehouse if you would like to see it.

## Advocating sustainability for almost three decades

Wenneberg defines sustainability in construction as resource consciousness that is in reasonable proportion to our commitment to the Paris Agreement and the 17 UN goals for sustainable development.

– The definition of sustainability in the Brundtland Report is still viable: “Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” That’s the definition I always use, since I first read the report in 1987, encouraged by my social studies teacher when I was a third-year student at Haslev Gymnasium. I was already socially and politically engaged, but my engagement towards a greener future started right there, reading that report. It was a natural progress for me as a child who had already engaged in things such as the Panda Club of the World Wildlife Fund and Greenpeace. I lived in the countryside and was concerned about our water well in the courtyard being contaminated with the pesticide Roundup from our neighbours in the surrounding fields. I was so angry; I could not help but take action. It’s been my whole life.

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**“89 percent of the population are willing to make sacrifices if it helps the climate crisis. What we need is legislation that ensures equal conditions for all actors in the sector!”**

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## Denmark’s largest climate media

Signe Wenneberg – who has a degree in Rhetoric and Journalism – has pursued a journalistic career covering culture and climate since 1991. Her format is investigative and critical journalism, but her most influential platform is social media.

– I used to write for newspapers and magazines, but I decided to move my activities to Instagram because I don’t want to be behind a paywall. Readers of all ages from all over the country follow my posts. I have an exposure of 3.6 million on Instagram, which some commentators have suggested might actually be Denmark’s largest climate media channel. I have no assistants, designers, photographers or any editorial staff. It is like running a little green newspaper – I work twelve hours a day to keep this running. I get the energy from a desire to change things. And there is no time to waste, so I just have to get these stories out in a format that is easily accessible and understandable to the widest possible audience.

## Awareness about overconsumption for ordinary citizens

Wenneberg focuses on the problems with demolition and replacing original building parts that do not need to be replaced. One of the cases she has brought attention to is Hotel Kolding Fjord, where she stayed and fell in love with the wonderful windows, presented in her Instagram feed.

– Later I learned from a reader that the hotel was in the process of replacing these windows. I thought this was a devastating thing to do, especially since the hotel has an articulated sustainable profile and is listed as National Heritage. A beautiful place, once a hospital in a pre-historic pandemic, now a high-end hotel where President Obama has slept. Anyway. You just cannot replace hundreds and hundreds of old quality windows, still in fantastic condition! This turned out to be the beginning of a long story. This unsustainable decision was the verdict of an external advisor, who did not grasp the quality of original heartwood windows – nor the impact of the Paris agreement and the SDG's. I had to dig into the back story: Who benefits from the purchase of a hundred new windows? The building is owned by the Danish Nurses' Organization. Is this how the nurses' money should be spent? The story kept unfolding and showcased how some companies defines themselves as green – and keep making black decisions.

Wenneberg is creating a wide awareness about the overuse of materials, stretching from senseless demolitions to the intense consumption of food and textiles.

– We use way too many new materials. The demolition of a heritage-listed house is an unbelievable loss of value. I have raised awareness of houses threatened of being demolished, and it might be worth it just saving one house by that opinion. We need to use less, and we need to share housing, but the Danish Minister of Social affairs and Housing seems to be unconcerned by these questions. What situation does that put the population in, when the responsible ministry doesn't act according to the climate crisis? It seems like they are unaware that construction and housing accounts for 40 percent of the total carbon footprint.<sup>1</sup>

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**“I don't think politicians understand that the situation has built up to a point not far from revolution.”**

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## Equal conditions for all stakeholders

In her contact with readers and followers, Signe Wenneberg has observed an increased sense of disillusion with the way that politicians deal with the most severe crisis of our times.

– I don't think politicians understand that the situation has built up to a point not far from revolution. I don't think they have a clue of how dissatisfied and frustrated people are. People do not sense that politicians pay any attention to them, and the fact that 89 percent of the population are willing to make sacrifices if it helps the climate crisis.<sup>2</sup> What we need is legislation that ensures equal conditions for all actors in the sector!

– If all actors in the sector were bound by the Paris compliant legislation, they would not have to compete with the ones willing to offer the

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1 Global CO2 emissions from buildings: <https://www.iea.org/data-and-statistics/charts/global-co2-emissions-from-buildings-including-embodied-emissions-from-new-construction-2022>

2 »Opløftende og overraskende«: Vores globale medborgere er mere villige til klimahandling, end vi tror: <https://www.information.dk/udland/2024/02/oploeftende-overraskende-vores-globale-medborgere-mere-villige-klimahandling-tror>

cheap and unsustainable solution to their clients. They could just tell their customers; you may wish to tear this building down not reusing as much as a brick or build with prefabricated concrete components, but that is not legal, so instead I can offer you this ethical solution. There needs to be legislation saying everything must be reused on-site and setting clear guidelines for what is allowed, so that it would not be left to the knowledge or abilities to convince of the individual advisor, architect, craftsman as we see now.

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## **“How can we sacrifice all of our cultural identity because someone wants to sell products?”**

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### **Political inaction**

With the Reduction Roadmap Charter, the majority of the Danish construction industry is demanding to be regulated with ambitious emission requirements that meet the Paris Agreement. Nevertheless, politicians are ignoring their call and set a target with a significant overshoot. The question is why political ambition keeps aiming much lower than what is needed to reach the Paris agreement, Signe Wenneberg says.

– Local and national politicians are more concerned with being re-elected than dealing with the biggest questions of our time. This is eating away at their trust capital. It is not a small thing, having signed the Paris Agreement to reach the 2030 goals – it is a commitment, and it is your job as a politician to attend to the work that extends into the future, ensuring the lives of coming generations.

– There is a sense that people are losing faith in representative democracy as reliable a form of governance to solve the climate crisis – either because it is not indeed representative enough for people to feel that their future interests are being taken seriously or because it is too inflected by undue market interests.

Signe Wenneberg thinks of democracy as a mirror of the human desire to accumulate and gather.

– It has proven efficient in securing monetary growth resulting in increasing wealth and access to more benefits for the masses but in this process, market forces have taken a central role in responding to human needs or desires with an ever-growing array of products and services. And we have allowed these interests too far into the control room. The climate crisis requires the opposite of our immediate desires. It requires self-moderation, degrowth, an economy of sufficiency and a limited approach to resource consumption. The question is if the human brain is capable of separating the notion of freedom and wellbeing from access to material commodities?

### **Cultural identity over market mechanisms**

Signe Wenneberg makes communication of sustainable values look easy, but the clarity and consistency of her messages is the result of staying



with the focus, using real examples from everyday life. In fact, any building in Denmark could be an example.

– We need to get to a point where we say that the built environment is a resource in itself. We should focus on creating legislation to enforce the preservation of all houses throughout Denmark. If something is preserved, then you have to apply and give really good arguments to take a building down. The built environment is a reflection of our lives, and how they were lived. We can't take that away just to put up a generic concrete construction, where each square meter exceeds planetary boundaries.

– How can we sacrifice all of our cultural identity because someone wants to sell products? Of course, the windowmakers' calculations will show that your old windows need to be replaced. I don't understand how consumption has been allowed to run so wild. It's overconsumption gone wild.

## A growing movement

Signe Wenneberg has been frustrated for a long time, having worked with these issues for decades, with an increasing sense that politicians are not listening. In her early days of engagement, it was firmly established that if consumption continued in the same manner, it would have a negative effect on the lives of future generations. Then consumption just became even more rampant. Moving towards a point of no return, Wenneberg reads the signs of the times.

– Something is starting to happen underground. The young are seeking knowledge, and they want to take action. What's making this movement grow now is that the state of things is dawning on ordinary citizens. For every post I write, these people get a clearer picture of what is going on. That's what's keeping me fuelled.



Photo: Zuhai Kocan

# Shared house – double gain

**Louise Heebøll, architect MAA, founder and owner of Louise Heebøll ApS, founder of the association Del Hus and V!GØR**

Louise Heebøll is an architect and urban strategist and the initiator of a movement to transform single family homes into two or more family homes. Her main work is to act upon the insight that circularity in construction and architecture can be intensified by a more adequate use. The associations founded by Heebøll show that circularity is intensified by dwellers themselves, as they gain mobility within the housing market and get access to a more fitted living space within existing residential buildings.

## Using what we already have

– The most sustainable building is the one that already exists in the fabric of urban space. So, the question to be asked before every new building is – should it be built at all? By retrofitting and transforming, we can build with a very low impact. Today, more people are talking about regenerative architecture, but in all honesty, architecture can never be fully regenerative. So, we need to ask ourselves: How can we use what we actually already have? There are a lot more opportunities in that, and I am in the process of discovering this, together with others who want to challenge the only idea of growth as adding new stuff and new buildings. This mindset still lingers from the last century, when the general perception was that there was nothing wrong with consumption, and all new stuff was good for the economy. The whole paradigm of the building industry is still in the last century mindset, to build and keep on building, but parallel to this there is a growing a culture of doing something with what we already have.

## Housing for a new demographic landscape

Del Hus presents a solution both to increased reuse of the built environment, but also to the need of appropriate housing for a growing group of people. It was based on this need that Del Hus was started.

– I was a single parent and I was looking for a house, something close to the city, the kind of ideal situation you dream of, near my daughter's school. But I couldn't find anything that was small enough for me and her, there was nothing on the housing market in the detached house segment that was a fit for our size of household. When talking about this with a friend, they suggested we would share a house, and this is where it all started from. It had never occurred to me that I could have access to this type of housing, and that sharing a house would be possible. This started my research and experimentation with how a house could be shared between more households, in a way that creates quality of life.

The movement to share houses is slowly growing, as more people discover the advantages of having just enough space. As a founder of the association Del Hus, Louise Heebøll has gone through the entire process, from first thoughts to the legal details.

– Del Hus supports the process of dividing a house in two or more households. The process is complex, which is why people still hesitate. But hesitation mainly concerns the question of how less space could be better. Asking yourself 'can I have a good life in a smaller living space' expands the question into your life balance. Paying for less space means having more time with your loved ones, more contact with your surroundings. More quality instead of quantity.

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**"The total population of Denmark is meanwhile not increasing by much, but many new houses are being built as a response to the need of many new households due to changed family patterns and ageing populations."**

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## Connectedness and quality of life

In Del Hus, Louise Heebøll is both an architect, a pedagogue and a bit of a life coach too.

– The people who are interested in Del Hus, are often unhappy with their situation, and they have a feeling that something has to change and could be changed. They have typically worked full-time jobs to make money to buy a full house, but even with the right job they find that the kind of living they search for is out of reach. They come to Del Hus with that frustration, and with feelings of loneliness. I get quite a lot of emails from people who are unhappy about their situation, not being able to get loans, for instance.

But in Del Hus, this frustration is transformed into energy to change. We have a lot of discussions together, learning that you are not alone in the desire to make positive changes. Along the process you will also learn a lot, as in get more understanding of the history of a building.

Del Hus presents a solution in a societal situation where the number of households is increasing in Denmark, while the number of people per household is going down. This is due to people getting older, an increasing number of single parent households, and other demographic and social structures. The total population of Denmark is meanwhile not increasing by much, but many new houses are being built as a response to the need of many new households due to changed family patterns and ageing populations. Louise Heebøll was soon involved with all the aspects of house sharing, as it is a complex process.

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**“The buildings we work with would often have needed a thorough restoration anyway, so the transformation is often a part of an upgrading process.”**

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As an architect, Louise Heebøll accepts the challenge that the reuse movement introduces into the profession.

– Well, we must change the design process anyway so why not focus on creating new business models. In V!GØR the business model is to look at the creative process, looking at what is there and what do we want, then how do we make that. For every step of the process, you need to find recycled building material, as locally as possible, and this could be a challenge, so the design process has to be flexible. In a way the creative process is turned upside down. At first, this process is received with some confusion – why not build a new sustainable house? But no matter what we consume, it's still consumption and it's still taking something away from the planet.

– We have worked our way on all the questions of what is required in turning a house into more households. Being single does not have to mean being alone. Apart from the technical requirements and the building processes, legislation is a part of what needs to work when dividing existing houses in smaller entities and how building permits work.

As an architect, Louise Heebøll assessed the possibilities of adding bathrooms and kitchens and the general transformation ideas. Del Hus then hires architects to draw the solutions.

– We have found that big companies in architecture as well as builders and craftspeople generally do not work with smaller residential transformation projects like these, so we are mainly working with SME's – small and medium-sized enterprises. In the building process, the role of developer is often the owner, but it could also be an architect, and we also have a few architects as owners. The actual division is different for each house, it could be one floor per household or a vertical division with two smaller floors each, even one-floor houses can be split into two households. It is quite simple to find the dividing solution, but we also want to make the construction process as smooth and efficient as possible. The buildings we work with would often have needed a thorough restoration anyway, so the transformation is often a part of an upgrading process and optimization of energy systems and replacement of hazardous material and other necessary measures.

## More than just marriage

The biggest challenge in the process is to get a financial forecast based on knowledge of the process. Banks are not used to the process and struggle with the risk assessment. Another barrier is how to define the ownership and the relationship between the parties who share the house.

– The construction process, surprisingly, is a minor part of the process. Installations are more complicated, as they need to be separated, subdivided, and doubled – again, considering that the installations would have had to be renovated anyhow. We need to collect a body of knowledge of this type of transformation process. Some private home builders might have done this on their own, but this knowledge stays with them since it is usually a 'once in a lifetime' kind of project. Del Hus works towards predictability, to facilitate loan-giving by having proper calculations and know-how behind the decisions. The financing system is not prepared for this type of projects. If you go to the bank and tell them you are buying an old house, and plan to demolish it and build a new one, they are right along with you. The banks do not have any products ready on the shelf for these new approaches to property. The forms of sharing need to be discussed too, what type of contract is established between the house owners, their responsibilities and so on. It could be in the form of a company, a fund or other regulating forms – but it is obvious that there is a need to develop alternative legal forms of living under one roof other than the institution of marriage.

The economy should be sustainable to begin with, and our calculation in Del Hus is quite healthy. Two small houses cost more on the market than one big house, so that the expenses of subdividing are returned in most cases. The key is getting a bridging loan to finance the expenses in the transformation phase. This can be repaid when the other half of the house is sold. I have identified this as the biggest financing barrier in this kind of project, this needs to be addressed by financial institutions somehow.

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**“Many people do not feel entitled to follow ideas like this, if you are a single parent for instance – do you have the feeling that you can change your life in this way?”**

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## A cultural shift

Despite all the challenges mentioned here, Louise Heebøll claims that the biggest barrier is cultural.

– Our main struggle is to overcome the cultural barriers, both in the building industry and in the social structures. We have to get finance and regulations into place, but the cultural shift is harder to overcome. Many people do not feel entitled to follow ideas like this, if you are a single parent for instance – do you have the feeling that you can change your life in this way? The typology of co-housing is growing, even if it “does not exist” in the perspective of finance and real estate legislation. It is an alternative for all types of single households, for seniors it opens a lot of possibilities.

Take for instance a retired person who would like to stay in the same area but their house is too big for them. What are their options? By selling off half of the house, gaining a more secure financial situation, even a more social life, provides quality of life right where you live, in an appropriately sized home.

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**“This is why this is also a democratic movement, where more people and new groups of people are getting access to existing qualities of housing.”**

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## **A classic start-up story**

Louise Heebøll has identified a hole in the market, answering the needs of a growing group of people.

– It’s a classical startup story, but still, this size of projects is a small potato in the building industry. Building companies and funders are not really interested in developments less than 5000 square meters.

– The way ahead may be hard to see if you just keep on building, then you miss all the possibilities of existing buildings. From the political side, we should adapt to a new approach like “Bevar eller forklar” – a catchphrase that could be translated as “spare or declare” – that is you can only demolish something having made a proper account for the reasons. This is why this is also a democratic movement, where more people and new groups of people are getting access to existing qualities of housing. We have enough houses, and we have enough square meters to share.



Photo: Codesign

# Architecture in the long run

**Peter Ullstad, architect, founder of Codesign, Sweden**

Peter Ullstad has been running the office Codesign along sustainable principles for 15 years, with a broad definition of a sustainable practice: from circular practice and social responsibility to governance. Codesign is part of the research consortium Återhus, where actors collaborate to change business performance in reuse of buildings and building material. Ullstad takes us back to the basics of the infrastructure for reuse.

## Distribution and overview of resources

– In order to reuse things, there must be a connection between someone who has the thing and someone who needs the thing. So, we need a market platform, storage, sustainable transportation, security in terms of quality assurance and insurance clearance of the material, and digitalization to carry the data of all the material. When you look at all these factors together, you see that it is impossible for small actors to handle this, I would say, not even the biggest actors in the building industry would be able to encompass all these processes. So, there is a need to design overarching systems and solutions to facilitate a smooth redistribution of used materials. For this to function, we must look to the national and maybe EU level, which makes this a quite steep slope to climb, but it is a challenge we are facing.

## Comprehensive system integration

The task list of getting everything in place for a reuse platform might seem overwhelming, but Peter Ullstad claims that there is quite a clear idea of what it takes.

– We need legislation. This must come from a political decision-making level. The market has had its time to solve it, and now we realize it will not be able to pull the transition off because the threshold is too high for the market. We already know empirically that it is possible and safe to reuse building materials – we have examples at various scales in all Nordic countries. We know how to digitalize objects and put them on an online market, in this case tagging the reused material with an individual code with quality and storage location. We know all these things, but we need to combine them into a system. Storage is a key issue. When you take down a very large office building of 30 000 square metres. You need about 50,000 square metres just to store the material of one floor of the original building, which corresponds to 6 football fields<sup>3</sup>.

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**“Currently, recycled material is expensive, but that’s because the system still supports the flow of new material instead of reused building material – this is of course a question of regulation ahead.”**

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Research on circular flows of building material is carried out by the research institute RISE in Sweden, looking into the questions of quality of recycled materials, among other issues aiming at reducing the waste of construction and demolition materials.<sup>4</sup> But we comparable need data from all the Nordic Countries, Peter Ullstad emphasizes.

– Research and proof of concept is crucial for circular development. We have pilot studies showing the resource savings and reduced CO2 emission in numbers. We can ensure quality, in numbers ensured by testing. All these tests have proved that it is possible to recycle materials in testing. Currently, recycled material is expensive, but that’s because the system still supports the flow of new material instead of reused building material – this is of course a question of regulation ahead. Regarding quality – this is complicated of course. The CE label has been in use in EU since 1996. Before that, there were no equivalent labels. The regulation of quality labeling needs to account for materials used before the standard of 1996, when most of today’s recyclable material was produced.

## Political leverage

– The EU is looking out for where CO2 emissions are highest. And the building industry is always looking to reduce costs. It is easy to identify the built environment as the easiest way to reduce CO2 equivalents in terms of return on regulations. So, it’s much cheaper to regulate the reuse of material in the building industry than most other things that we do to save the planet. In a building, the “invisible” walls and floors are the most efficient and important to deal with – rather than the very visible recycle waste bins in the entrance. The public will not know if the structure they

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3 Calculation: store slabs of 3000 sqm, five on top of each other = 6 000 times 2 since the houses are approx. 10 stories high. Windows 500 sqm. Doors 500 sqm. WC’s 1000 sqm. Roof 300 sqm. Inner walls 1000 sqm. Floors 1000 sqm. Ceiling 800 sqm. Installations 2000 sqm. Façade 2000 sqm. Steel 2000 sqm. Stairs 400 sqm. Insulation 500 sqm. The rest 2500 sqm. Storage transportation +70%. Staff space 400 sqm. All together it is approx. 46 000 sqm storage space needed to store 1 office building of 30 000, which equals to 6 football fields (7300 sqm each). And that is only one office building.

4 Circular flows of building materials, RISE: <https://www.ri.se/en/what-we-do/expertises/atervinning-av-bygg-och-rivningsavfall>



walk on is built with recycled beams – and frankly they won't care whether it is a 1-year or a 30-year-old beam. For politicians, this system change – promoting reused rather than new material in the building industry – should be an interesting thing to look at. There is a big lever for change in the field of circular flows of building material, but it has yet to become a question for the electorate.

The recycling strategy might start on a national level, that then influences the EU and in essence has a global effect in the end, as the result of scaling.

Peter Ullstad explains the difficulty of scaling circularity in the built environment.

– It is a bit of an intellectual dilemma that the human impulse is to scale up, as if that was the only way to increase something or make it a daily business. Between 20 and 40 percent of CO2 emissions come from the building industry, depending on what country you are in. Sweden is currently on 21 percent. We have to understand that right now we're building the equivalent mass of the city of Paris every five days on the globe<sup>5</sup> And right now, we don't reuse anything, not even one percent. But what we recycle today is such a small percentage that it's impossible to scale from the current less than one percent to ideally ninety two percent. We're going to scale up several hundred or thousand percent, and that is not possible for the industry to take care of on its own. Political pressure and incentivization is crucial here.

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**“The idea of ‘new material is the best material’ has had a deep impact on our design so far, but the acceptance for second hand is growing, for the sake of quality and aesthetics, sometimes at a higher price than something new.”**

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## Proof of concept

The idea to go from pilots proving both the business model and the infrastructure to achieving enough circular volumes to pave the way for legislation is a high-stake approach. Peter Ullstad points out that the cost of bringing a circular strategy from a national to the EU level requires financing from the EU.

– In a number of European countries, Germany, Benelux, France and Scandinavia, we have now proof of concept that the recycle market is viable, as shown in a number of KPI: s (key performance indicators). So, if we can show that we are building a logistical and financial system that works. Once we can show that the system works, we could approach for example municipal level of regulations, like the cities in Sweden, to implement a system where they can demand from builders and developers that reuse must be a substantial part of their building projects. The regulation could for example state that unless you have 20 percent reused material, you will not get a building permit or get a land allocation agreement. They could also decide that you cannot take a building down unless you

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<sup>5</sup> UN plan promises massive emission cuts in the construction sector – the most polluting and toughest to decarbonise: <https://www.unep.org/news-and-stories/press-release/un-plan-promises-massive-emission-cuts-construction-sector-most>

recycle 100 percent of the material on the demolition site. However, you can't demand this from the market yet, because there is no possibility of getting hold of reused material on the desired scale.

## The design process turned upside-down

Throughout history, construction parts of all kinds and sizes have been inserted in new buildings, such as spolia. Bringing this tradition forward, Peter Ullstad is confident that circular materials will have a positive effect on design thinking and architectural aesthetics.

– As architects, we never start with a blank sheet of paper – the architect responds to the program, the site, the budget, standards and regulations, and so on. In the same way, it is indeed possible to start with the structural parts and see what can be achieved. But we need to do this at a scale and magnitude that we haven't dealt with before. We are, as architects, used to having guiding frames, and we design within this. The idea of "new material is the best material" has had a deep impact on our design so far, but the acceptance for second hand is growing, for the sake of quality and aesthetics, sometimes at a higher price than something new.

## A system in time and space

Returning to the question of a logistical system, there is the need to find material, not just fitted to size and style, but allocate the material in time as well as space. If an architect wins a competition where the design depends on a certain lot of windows, doors, and structural elements, will there be any possibility of putting in a "reservation" for the desired material? Peter Ullstad has thought a bit about this.

– If we have a national digital platform. The reserved material should be labelled for the site it is intended for, so if there are more contestants on the same building site, the system can identify this. Then there is the question of whether you should pay a booking fee for the desired material, and whose budget that would be on.

## Eternal life

In a system where availability of resources and components will define aesthetics and processes, the design task will be different, that is for sure, while achieving a better carbon footprint, we will learn what we could expect from reused material in terms of measures and quality. We will be putting all things together in a new way. We have all the ingredients; the recipes will be developed along the way. But the scale we are at now, it is like trying to bake a loaf of bread using the flour dust that lies around the bakery. The industry is not even close to a percentage of reused building material, but on some project levels, the percentage of reuse has begun to look quite decent in some cases. We need to look at a building and instead of identifying what can be reused, ask ourselves – what do we have to throw away, and at what cost. With this mindset, we will be able to treat every building as having eternal life.



Photo: Norwegian University of Science and Technology

# Preparing for the known and anticipating the unknown

**Pasi Aalto, Centre Director NTNU Wood, Department of Architecture and Technology, Norwegian University of Science and Technology**

As the Centre Director of the Department of Architecture and Technology at the Norwegian University of Science and Technology (NTNU), Pasi Aalto's work joins planning practices with circularity and ecosystems. They are taking non-human life forms into account in the making of data models that combine ecosystems, existing buildings, demographic development and health factors. Pasi Aalto describes the research model at NTNU as working very actively towards a positive future, rather than documenting and writing long reports on what is negative today. Aalto claims that just pinpointing problems is not enough, you must take action and make an effort to make things better.

– We constantly ask ourselves – what are future needs and how far ahead can we predict these. In education, we are dealing with what is called “wicked problems” – something that is highly complex and interconnected or is considered too difficult or impossible to solve because of its complex and interconnected nature. Every day we practise how to handle wicked problems and “unknowns” – these are not well behaved and detailed models; they are pathways and approaches that we can use to move forward.

## Sustainability – an evolving term

Pasi Aalto recalls a variety of definitions of sustainability in relation to construction.

– Sustainability is a woolly word, and it could be problematic because it makes greenwashing easier. In Norway as well as in the EU, sustainability was for a long time equal to energy savings. Gradually, a more holistic approach began to emerge, in the early days still very technology-driven, later associated with calculation instruments like LCA, embodied emissions in materials and so on. Over the last decade, sustainability in construction has become a more complex paradigm which includes social sustainability.

Ultimately, we will probably encounter "unknown unknowns" in the future, that will influence how we live and define sustainability in the future.

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**"At the end of this road towards sustainability we will probably arrive at de-growth and significantly reduced consumption by individuals, organisations and governments."**

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## Stuck in the growth paradigm

In relation to the social side of the holistic approach, the Norwegian regulation system has a particular bias, as Aalto explains:

– In Norway, being sustainable is connected to ownership, by the way that our policies are formulated. As an owner of a Tesla, for instance, you get the benefits of having an electric car. If you own your house, you get the governmental benefits. If you haven't consumed something "sustainable", you cannot be sustainable, in the government definition. There are a lot of people who live sustainable lives, who are omitted from the system of benefits, based on the way rules and regulations are formulated. Now, we see an increased understanding of energy citizenship, and an awareness of the agency of nature and ecosystems. This is putting a pressure on all the ways we think of sustainability. We have signed The Kunming-Montreal Global Biodiversity Framework (GBF), but all of our rules and regulations are based on spatial scales other than ecosystems. The big issue is that we are planning one building one municipality at a time, but ecosystems do not follow municipal borders. At the end of this road towards sustainability we will probably arrive at de-growth and significantly reduced consumption by individuals, organisations and governments. Currently, this is not on the agenda. If you pick up the strategy plan for Innovation Norway, it is all about growth.

## Home is a product

The Norwegian system of ownership is a particular trait of the housing sector, as Pasi Aalto point out:

– Norway is the only Nordic country that does not have what is called a "third housing sector" "There is a strong cultural goal for everyone to own

their own home and this is also the government strategy.

The consequence of this is of course that a home is not just a home but a product, and so it is designed to make a profit. If we are to change this, we need to make sure that our professional culture as architects allows for us to be more conscious about the efficiency of resources. If we hold on to the way we did things yesterday, and repeat the boxticking from the last project, there will be no transformation, and more importantly, we will continue to overuse resources the way we did yesterday too.

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**“A fundamental professional change would be if your professional integrity was protected by an oath “not to do damage”, in the way that a doctor’s loyalty is with the patient and the ethical code, and not for the hospital they currently work for.”**

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## **Handover of responsibility from politics to market**

Pasi Aalto describes the role of politics as something that has changed over the years. Into a political situation where a lot of activists and organizations want to open for a post-oil narrative in Norway.

– One of the problems we are facing in Norway is that politicians are not prepared for the narrative that will be created if they open up for a significant societal change. We turn to politics for answers, but all they have is tons of reports, dating thirty years back. You can spend a lifetime reading those. What has happened in politics is that they are not operative enough, they do not make decisions like they used to. There is a lot of trust in the market to sort things out, but of course the market will behave as a market and not as politicians. Placing the problem-solving in the market is a form of disclaimer from political responsibility. We need to achieve system change by working with the system, not against it. But for many people and companies, change will be all but comfortable. What about those who are employed in the oil industry? In Norway we have 120 000 people working in the building industry – what are they going to do? We will have to start by accepting the conditions and understanding that some jobs may not make it through to the climate compliant reality. Still of course, losing a company in a location where there are very few employers could be a disaster.

## **Sustainability under oath**

Despite all the challenges that follow in the change of narrative, Pasi Aalto senses that a change is happening, where an awareness of responsibility is finding its way back into profession as well as politics, and that legislation could consolidate this approach.

– There is a paradigm shift in the air. Now, we know that we are not circulating enough. We keep demolishing things and destroying huge values. We fail to see the consequences of this. But a zeitgeist is forming right now. There, architecture has become something we have to do with the

knowledge and perspective of an entire ecosystem, taking an entirely holistic approach, which is a huge undertaking. But the reality is that you have a client, and you get paid to do what that client needs. A fundamental professional change would be if your professional integrity was protected by an oath “not to do damage”, in the way that a doctor’s loyalty is with the patient and the ethical code, and not for the hospital they currently work for. If the profession was protected by some legislative instrument, that would place responsibility inside the profession, this would be a fundamental change. Nobody is above the law. Having a profession is not to have a job, but to have knowledge that contributes to a better society. Right now, we see lots of ideas like this being introduced on the market side, where companies are founded on the principles of being for instance, 100 percent circular, and of course they attract competent people.

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**“If you don’t legislate to a certain level, the companies that do not care and are cheapest are benefiting by outbidding everyone that is trying to introduce more sustainable (and costly) approaches.”**

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## Need for market regulation

In addition to the ethical responsibility to create sustainable architecture with enduring values, Pasi Aalto describes the conditions for a system change to achieve quality.

– If you want a systems change, there cannot be too big a quality difference between the bottom and the top. Rules and regulations are used for raising the quality from the bottom level and up. Certifications like BREEAM and LEED have the effect of raising the quality of the top. It is in the area between these where competition happens. At the bottom there are the cheapest offers, achieving the bare minimum. But what happens above the top level? There is no movement at the top because they cannot compete and have nowhere to apply their knowledge. So there is more competition happening at the bottom level, where you can even formulate a business idea to be maximally efficient at the minimum level, and here is where the climate is sacrificed for a dime or two. So, if you don’t legislate to a certain level, the companies that do not care and are cheapest are benefiting by outbidding everyone that is trying to introduce more sustainable (and costly) approaches.

## Custodians of the built environment

On the role of architecture, Pasi Aalto offers some hope for the future with regards to the unique knowledge of architects.

– I think architects are – and will continue to be – proactive and willing to change. We can do a lot more to become like “custodians of the built environment”. We are the only professional group who has active knowledge about all aspects of the built environment and can work with the fabric of existing buildings with the focus of making them work for the future. This is what we should do; design to support a future activity, and to support the environment where that activity takes place. But if we hold on

to a cultural fetish of designing new buildings that are not aesthetically relevant outside the profession, then we will become irrelevant, a museal trade like barrel makers or blacksmiths.

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**“The idea is that nearly half of the architecture master students will focus, not on how to make new buildings, but work with existing buildings and material flows.”**

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In line with the discussion about responsibility, Pasi Aalto describes the process at hand in the academy, in the face of things to come.

– At NTNU, we have just cancelled eight master courses and replaced them with a course called Circular Studio, which will start in the fall of 2024. With this radical change of our program, the idea is that nearly half of the architecture master students will focus, not on how to make new buildings, but work with existing buildings and material flows. The analysis behind this involved looking at how many architects we have in Norway who know how to build new buildings – finding that we have enough of this competence, while there is a deep lack of knowledge in transforming existing buildings, updated knowledge about systems design, industrial ecology, ecosystems, industrial heritage theory and history, mapping and digitalization, reuse, sciences of circularity and so on. This is knowledge that is very costly now, to a point where it needs to be hired from separate consultants and experts, so this knowledge will be out of reach both in time and money. The only way we can get this knowledge into practice is by financing it from within higher education. The building sector will soon be where architects were about half a century ago, evolving from thinking that their business is to put up buildings, into realizing what kind of knowledge they need to take the sector to the next level as a constructive part of active, healthy and prosperous ecosystems.



Photo: Gustav Kaiser

# Learning from reality in development

**Anna Denell, Chief Sustainability Officer, Vasakronan, Chairwoman of "Håll Nollan" (Zero Accidents in the Construction Industry), advisory board member of Mistra Carbon Exit, LFM30 and Fria Byggakademien**

As chief Sustainability Officer at Vasakronan, Anna Denell is leading the company's strategies and experimentation in relation to sustainability. One of the pilot sustainability projects is the Lumi project in Uppsala which is currently Vasakronans biggest reuse project. With the realization that their biggest climate challenge is the use of construction material, Vasakronan takes this insight as the outset to rethinking their entire business idea of new development.

## Chasing the 100% reuse

– We just completed the office building Lumi in Uppsala, where we decided to keep the concrete structure from the 1970's, and where we aim at reusing much of the old interior material. The overall company objective in relation to circularity is to only use reused, recycled or renewable material in our construction work. We measure the result closely throughout all our projects, and we are currently at around 15 percent circular material. There is still a long way to go to fulfilling the 100 percent target, but we aim to take new steps in all projects that will be started going forward.

Anna Denell describes a new construction project in Gothenburg, where Vasakronan is working with the idea of developing the building by only using reused construction material.

– We have a clear understanding that it would be possible to find a suitable reused frame for roof, façade and windows, but we have to accept



that it is nearly impossible to find and install reused plumbing material, ventilation and elevators. Therefore, we need to challenge material producers of such material to at least use recycled or renewable material in their production. The hierarchy of material use is firstly to maximize the amount of reused material, next choice is using recycled material and as a last choice, renewable material. Carbon intensive virgin materials should be off the list completely. Of course, there is a step before reusing – that is, not using anything at all – so we consider every design choice very carefully and continually ask if we answer up to an actual need of space and functions before starting to use any material.

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**“This is an argument to stop – or seriously reduce – the use of virgin material, because of how complicated it is to remediate the loss of biodiversity.”**

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## Analyzing systemic implications of all choices

Change happens gradually, and Anna Denell's experience of Vasakronans transition is that some challenges are easier to address than others. Denell explains that you must identify the climate- and environmental effects everywhere, and carefully consider the effects of your choices throughout the entire process.

– Even if we never build on greenfield land, and develop exclusively on brownfield ground, we have to address the biodiversity problem that we might have in our value chain. For us, this is in the extraction of raw material, sourced for building material. We carefully analyze what type of material we are using and the possible loss of biodiversity where they are extracted. This is an argument to stop – or seriously reduce – the use of virgin material, because of how complicated it is to remediate the loss of biodiversity. If there is a material we cannot avoid using in the end, we should find every way of compensating for that material use. So, we have strong incentives in place, and we notice that this is received well both internally and by our stakeholders.

Anna Denell finds that recycling material is a question that is largely accepted, but when discussing reduction of newly built square meters and the reuse of existing buildings, she finds that there is more resistance to these ideas.

– We are not only an owner of existing buildings but also a development company and the business idea traditionally has been to develop new square meters. Reuse of the built environment is gradually becoming a viable business strategy but there are a lot of stakeholders in our industry who do not want to be challenged at all.

## Incentivizing change at contract level

Anna Denell is looking for all possible tools to promote intensified circularity in construction and architecture in Vasakronan's development projects. By revising the constructors' contract details, Vasakronan managed to shift the value of reused material.

– We looked closely at the material bonus that is in the contract with most contractors. Normally, we pay the contractor for the working hours, the material that is used and an extra gratuity of 15 percent added to the cost of the material. We decided to remove the 15 percent and replace this with a 20 percent bonus on all reused material. We have always wanted our contractors to prioritize reused material, but when we analyzed the contracts from before this shift, we found that they ended up using 100 percent new material, claiming there was no reused material to be found. When we changed the financial incentives, the contractors were suddenly able to find reused material to a larger extent than before. Some of them organized their own warehouses for reused material, and now we see a real change of mindset and behavior. This initiative of changing the procurement process was instantly accepted, there were contractors who were willing to sign agreements based on this new way of thinking.

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**“In Sweden, due to the way municipalities are selling land and are pursuing the zone planning process, municipalities are sometimes not interested in reusing existing buildings.”**

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## **Public procurement rules reinforce status quo**

In the process of finding new ways forward in the development business, Anna Denell has identified ways of practice in public management, showing that they too can be stuck in old ways, contributing to the climate crisis.

– In Sweden, due to the way municipalities are selling land and are pursuing the zone planning process, municipalities are sometimes not interested in reusing existing buildings. If a developer builds a new building, there is a possibility to place the costs at the developer's side for improvement of for example the infrastructure in the area, maybe adding a park, a new school or daycare center. To get the building permits or new detail zoning to be able to develop the new building, we comply to these requests, and pay for these services. But if we decide to reuse and renovate an existing building, we might not need the new permissions from the municipality, and they will not be able to force us to pay for municipal services.

We have a few examples of projects where the initial idea was to demolish and develop new buildings but where we now have another plan. In Alviks Strand, a former office area by the water, west of Stockholm city center, we found ourselves in a local planning process with the municipality, where we were supposed to demolish 65 000 square meters of office space, in order to develop approximately the same number of square meters of housing. We came to a point where we could not justify this, so we went to the Stockholm municipality, told them that we were not willing to proceed with this planning.

Anna Denell brings up yet another example of the unintended effects of the current development model.

– In Gäddviken, in Nacka east of Stockholm, the national theatre Dramaten and the Opera will move their workshops from the old coffee roastery, where we are currently planning a conversion to residential housing where we try to keep as much of the existing building and cut into smaller residential blocks. The municipality would probably have preferred us to demolish and build a new building, so that they could take profit of our added value and charge us for surrounding services and infrastructure. The regulating authorities may not be aware of real-life effects of the regulations they impose. It is seen as a part of everyday business, nobody is breaking any laws, but there is an unintended side effect of the model, the way it works in practice and this needs to be revised.

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**“If you would only get the permission to change existing buildings and not demolish them, we would see a totally different system, I believe. The benefits of this change in procedures would be many.”**

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## Planning to avoid unintended consequences

In the future, Anna Denell would like to see a different planning process, based on a local plan with priority on keeping existing buildings.

– If you would only get the permission to change existing buildings and not demolish them, we would see a totally different system, I believe. The benefits of this change in procedures would be many; Giving building permissions for adding a few floors or do exterior renovations, would probably be a process that is easier to accept from the neighboring stakeholders. There would be less intrusion in exterior areas, more chances to keep public parks or football fields intact, the building process would be shorter and less noisy, less transports, processes would be less disruptive to the neighborhood.

Anna Denell thinks that increasing redeveloping, renovating and reusing material in Sweden and in the Nordic countries, would also improve the local market.

– If more material is refurbished and repaired locally, that would mean more job opportunities in a market that has seen more migrant workers, sometimes not treated or paid well, just doing general assembly work on construction sites around the world, Nordic countries are no exception. With the more local market comes a higher level of design and quality construction work, making our business a more interesting place to work, more challenging, but also more innovative and interesting processes.

## Undue interests

Looking closer at the development process, Anna Denell finds other examples of hidden incentives that interfere with sustainable choices.

– We are continuously looking at how we manage this interference of undue interests in contracts and agreements. In some areas you can find hidden financial incentives between the contractor and the seller of certain material. The contractor will get paid for using a certain type

of material, and to get the best bonuses, they want to use more of that material. We want all our stakeholders along the value chain to be able to be profitable, but this is an example of unsustainable incentives, encouraging an excess use of virgin material. We would like to see as much reused and repaired material in our buildings as possible. There are a few brave companies rethinking the way they deliver, at least they have a parallel business model selling new and reused material. Swegon is an example of a retailer of remanufactured material, tested and controlled cooling and ventilation products are resold with repair guarantees.

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**“The economic downturn is a window of opportunity for legislators to get to work now, so that the playing field is ready for the return of investors.”**

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## **A window of opportunity**

Among the positive outcomes of a transition to circular processes and material in development projects, is that we would get a better building sector and at the same time happier communities. When demolishing buildings, a huge area is transformed around the development, and following this, there might be a lot of protests from the community, which may in turn slow down the processes.

– Using existing buildings for redevelopment into housing, for example, will probably be a safer and quicker process, especially in urban centers. I hope that we use the current economic downturn well, to try and do things in a new way, and negotiate some of the obstacles to the transformation processes. We don't want to go back to where we were, when the economy picks up the pace. It would be terrible if an upturn will get everyone to just throw sustainable innovation to the side and go back to business as usual. The economic downturn is a window of opportunity for legislators to get to work now, so that the playing field is ready for the return of investors.

# Conclusion

The multitude of definitions of sustainability in construction is not a problem, on the contrary. Every actor is contributing with a piece of understanding, and the fact that they carry their own professional experience adds value to that piece. This series of articles are aiming at communicating this experience to a level of common understanding of the potential of sustainable development in the Nordic region. What tools do we have at hand, in relation to promoting intensified circularity in construction and architecture? In all sizes of operation, from recycled material suppliers to digitalization start-ups, innovative architects, insightful builders and sustainability expertise, we find representatives of a Nordic-based knowledge bank, filled with decades of research and fine-woven networks of people, spearheading change. Their stories are about overcoming all kinds of obstacles, replacing unsustainable with sustainable approaches to material use and reuse in construction and architecture.

Contrary to the common belief, architects do not worry about the design task in an era of reused buildings. Architecture was never about starting with a blank sheet of drawing paper. Circularity of materials in construction and architecture are simply new elements to the procedural design process, where recognising qualities of a site was always the first step of the process. In order to convince investors and finance, there will be a need for calculations. To make sure what we build is safe and long-lived, there will be a need for guarantees and regulations. To achieve accessibility, financial and physical, there will have to be standards and adaptations. But in all of this, nothing is new to the field of architecture. The role of architecture in relation to promoting transformation over new built is to be a communicative part of the huge dialogue that constitutes a building project.

We have enough alternatives to carbon intensive production of new materials – in fact we are surrounded by it – but the material needs to be organised in time and space. In the age of AI, this is a less awe-inspiring task than just ten years ago. This is the time to build with new knowledge in combination with technology, not with new material.

# About This Article

## Material hierarchies – shifting towards sustainable practices and material in construction

### Authors:

Text: Malin Zimm

Research: Pernille Martiny Modvig

### Other contributors:

Angelica Åkerman

Dorte Bo Bojesen

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