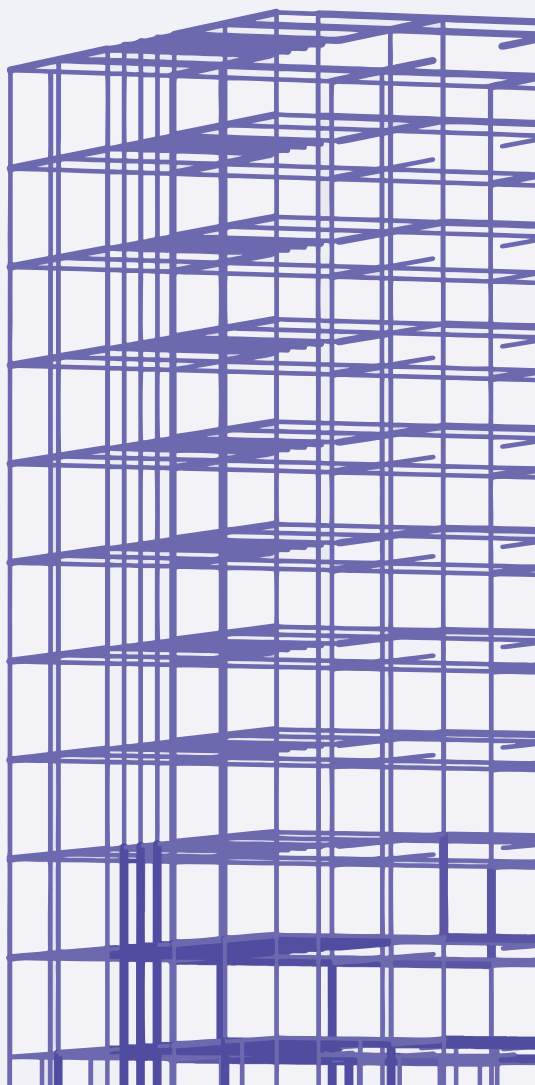


Rebuilt Buildings

How to build from what
is already built – at scale



Rebuilt Buildings presents a practically and economically applicable playbook of preset process for reusing structural components in new building. A logistics-and-bureaucracy plan lays down routes, storage, permit and certifications, making sure of going in the know. An adaptive-planning script allows structure to reshape itself to whatever the city releases each week. And a circular business layer converts avoided carbon, freed storage and deferred landfill fees into a viable scheme. With the chain rehearsed end-to-end, it clears a pathway from demolition to circular construction, not only in the future, but today.

1. Why to Rebuild Buildings?	
1.1 What's the matter?	11
1.2 Alternative logics	14
1.3 Rethink structures	19
1.4 What's the question?	26
Visual Intermezzo – Structures in reuse	32
2. How to Rebuild a Building?	
2.1 The building brief	51
2.2 Form follows availability	56
2.3 The Flows, The Wait, and the Bureaucracy	82
2.4 Values: economic and beyond	104
Visual Intermezzo – Structures in reuse	120
3. What to imagine to Rebuild Buildings?	
3.1 What's next	140
3.2 Long projections	142
Call for Continuation	150
Visual Intermezzo – The future of Rebuilding Buildings	153
Appendix	162
Sources	168
Credits	172

Rebuilt Buildings – From a Material to Logistical Society

Construction is not only a matter of form or material. It is a system of flows, contracts, habits, and infrastructures. In short, construction is the culture of our material society.

Seen within global environmental interdependence, construction is a costly investment that must be used with moderation. When it comes to providing usable spaces, it cannot be overstated that we must first use, preserve, care for, and eventually reuse what is already built, or as Carl Elefantec famously coined “the most sustainable building is the one that is already built”.ⁱ

Yet, planetary material finiteness demands that extracted and manufactured elements remain in circulation at their highest integrity for as long as possible, within the so-called *circular economy*. Paradoxically, in pursuing this transition, virtuous construction remains closely intertwined with demolition. As architects Michaël Thyoot and Tom Schoonjans from ROTOR, the Belgian reuse powerhouse, remind us, “today (...) *salvage remains closely intertwined with large-scale, often premature and always controversial demolition*”ⁱⁱ Circular construction, however necessary, is inseparable from deconstruction.

The needs for preservation and circular deconstruction are seemingly diverging, yet both can be true at once, and, as continue Thyoot and Schoonjans, “*coming to terms with this contradiction is a continuous exercise*”.ⁱⁱⁱ

If to build is to destroy, as the architect Charlotte Malterre-Barthes argued^{iv}, then across Europe a regulatory and cultural momentum is forming around its complement: *to destroy is to build*. When demolition becomes inevitable, then it must become constructive.

For over a couple of decades, a rich cultural production in architecture has revived salvage as a field of experimentation, extending a centuries-old practice. Most recent illustrations include *Thoravej 29 and the Venice Biennale 2025 Danish Pavilion by Pihlmann Architects*, *the under-development Recycling Centre in Brussels by TEN and Babini Geysen*, or *the K118 Kopfbau by baubüro in situ*, as explorations of beauty of reclaimed materials and

narratives of second life.

Given the competitive and authorship-driven nature of the architectural field, these works are intended to be *singular*. They operate as one-offs, demonstrating that reuse in construction can be environmentally, spatially, and aesthetically compelling, and that it is not only possible, but capable of producing highly desirable individual experiences.

Alongside this, more *generic* fields of policy and legislation unfold across different levels of governance: global climate mitigation scenarios, transnational material security agendas, national industrial strategies, and local waste management systems. Regulatory and financial interventions, often driven by grassroots lobbying movements, increasingly seek to tilt conditions toward circularity at scale.

If *singular* architectural interventions are the cultural push towards circular construction, generic regulatory interventions are the institutional pull towards it.

Both are necessary, yet they rarely meet. As the building industry and architectural profession are urged to rely less on new construction as their primary economic driver, rebuilding buildings emerges at the interface between cultural production and logistical coordination. Here, commercial, administrative, and legal structures must evolve for this new circular normal.

Circular solutions depend on partnerships across a value chain that coordinates how materials move from design to use and, as late as possible, to deconstruction. For instance, governments set fiscal and technical standards, local authorities issue permits, contractors and distributors salvage and store materials, architects integrate reused components into projects. Each actor in the chain is interdependent.

What would it then mean to design, source, finance, and construct buildings in this new reality?

If our material society has to give way to a more logistical one, we are facing different emerging conditions, not only contained in defining how to assemble components, but also equally concerned with time- and place-based logistics. The timing of deconstruction and construction. The duration of storage. The location of

building donors and received. The spatial and more-than-spatial elements of circular construction.

This research is situated precisely at these intersections.

Rebuilt Buildings does not propose a single solution. It uses the building as a vehicle to explore how chains of knowledge and responsibility can be reorganised and sustained. It treats spatial design not only as form-making, but as coordination.

Embedded within a public grant scheme dedicated to circular chain collaborations, the research reflects a growing recognition that circularity depends less on isolated innovation than on sustained relationships and shared practice.

It situates itself within an emerging field of practices that facilitate reuse through logistics while experimenting with new organisational forms. In France, architects of *Encore Heureux* co-founded *Remix*, a consultancy for reuse coordination. In East London, the just inaugurated *Tipping Point East hub* by *Yes Make*, *RESOLVE Collective*, and *Material Cultures* provides storage for salvaged materials. In Brussels, Rotor DC operates as both deconstruction company and reclaimed material platform.

Numerous nameless and faceless public and private actors already form the scaffolding of circular construction, visible in directories such as *Salvo* or *Opalis*. So, no, besides what the profession might tend to believe at times, architects are not (once again) about to save the world. But architects' efforts in using their agency and skillset to propose alternative infrastructures and cultures of building instead of perpetuating the cycle of endless construction can only be encouraged. In aiming to align their activities with their values, as ethics translates in working cultures, these practices taking on these new roles in the chains are efforts to sustain their activities in the market they are creating, which can also, in turn, contribute to a generalized circular material society.

While it would be delusional to expect circular alternatives to satisfy current staggering demand for building materials, developing an ecosystem of circular practices has the potential to reorganise how and with what we build, and in doing so, it can force us to question the culture of our material society.

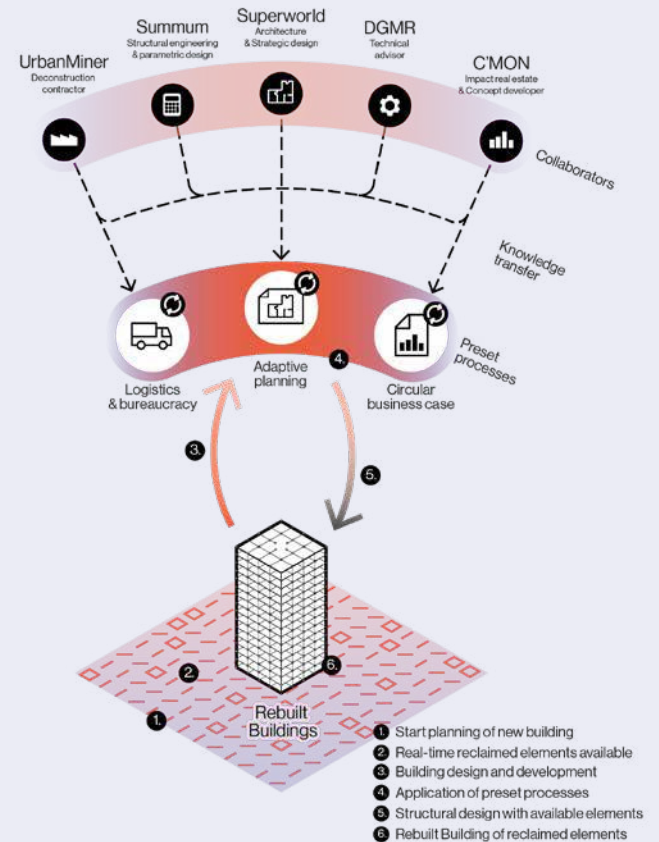
Internalising construction's externalities also brings home the effects long displaced to what the Australian feminist and eco-philosopher Val Plumwood called "shadow places", or the distant invisible places that "provide our material and ecological support".^v

The shift from a material to a logistical economy will

introduce new local frictions, such as increased local transit or transport pollution. Yet these frictions may prove productive, disincentivising our collective reliance on new construction and placing greater emphasis on maintenance and care as collective infrastructure.

Keller Easterling, architect and writer, said "unbuilding is the other half of building."^{vi} In this shift, it may be as important to consider construction and deconstruction as inseparable parts of the culture of our material society.

Maxime Cunin



1

Why to Rebuild Buildings?

The ways we currently organize the design, the construction, and the use of buildings are incompatible with the finiteness of material resources – think of sand, aggregate, minerals, metals and the likes – as well as what can be attributed as the direct consequences linked to their uses on climate and planetary boundaries.

1.1 What's the matter?

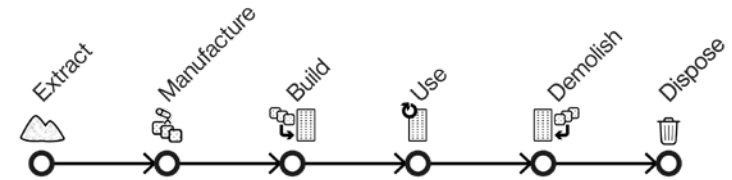


Fig. 1. The linear process of building today

Carbon intensive – Globally, buildings are responsible for approximately 40% of carbon emissions. In the Netherlands, the built environment contributes to 12% of national CO₂ emissions, with 11% attributed to material extraction, production, and construction processes.

Material hungry – At the same time, of the 100 Gt of materials we extract each year globally, construction is responsible for nearly 40%.

Waste burdening – Waste arising from the construction and demolition of buildings and infrastructure represents more than a third of all waste materials generated in the EU. In the Netherlands, construction and demolition waste constituted approximately 35% of the nation's total waste generation.

Price insecurity – In the Netherlands, the price of primary building materials, such as steel and concrete, has risen sharply—by over 30% between 2020 and 2023—due to supply chain disruptions, geopolitical tensions, and energy price volatility.

Accelerating pace – All of these challenges are poised to become more acute in the coming years as the planned volume of new construction adds to the pressure on resources and intensifies tensions. The Netherlands aims to add 900,000 new homes by 2030 to address housing shortages, which are challenging not only in scale, but also in pace.

Today, economic prosperity remains tightly coupled with energy consumption and material extraction. We must rethink what it means to construct, and to live in a materially conscious society. More than that, we must redefine our relationship with what we produce and build—treating buildings and their components as precious, rare, and valuable, rather than disposable.

The risks of material shortages, price volatility, and a rapidly shrinking carbon budget leave us with no choice: we must drastically reassess how and where we use materials, making the fullest possible use of what is already made.

To build today is to recast design as an infrastructural practice—aligning materials, processes, and time so that the structures of yesterday can sustain the needs of tomorrow.



Fig. 2. New built homes in the Netherlands

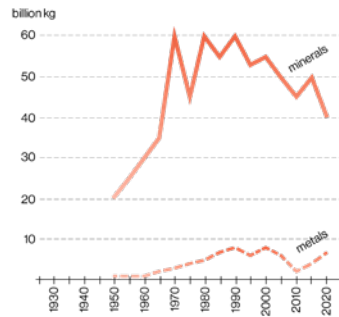


Fig. 3. Domestic material consumption

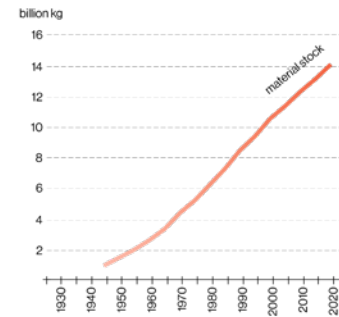


Fig. 6. Material addition to the urban mine



Fig. 4. Demolished homes in the Netherlands

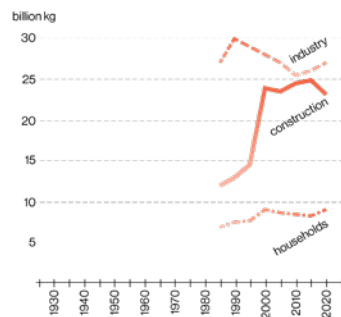


Fig. 5. Domestic waste production

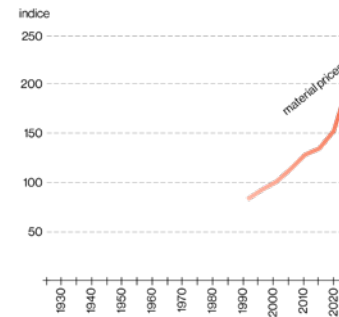


Fig. 7. Building materials price indices

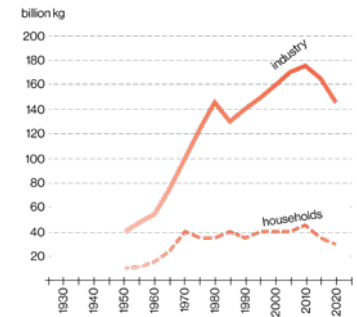


Fig. 8. Domestic CO2 emissions

1.2 Alternative logics

The Netherlands alone has an estimated 7.5 to 10 billion tons of material embedded in its built environment— a massive stock of potential resources. If circularity is to move beyond an ambition, this vast reserve must be treated as a primary material source, not an afterthought. The question is no longer whether we should reuse buildings, but how we systematically shift towards doing so.

➤ The Circular Mirage

In 2016, the Dutch national government announced its ambition for a waste-free economy by 2050. Today, nearly half of the country's total waste comes from construction and demolition, and a stunning 97 percent of it was classified as "recovered" in 2018. So, it does not look so bad, right?

Yet, circularity in construction remains more of a statistical achievement than a material reality. In 2022 in the Netherlands, around 30.6% of the materials used in the economy came from recycled waste materials in 2023, indicating that only about one-third of material inputs were secondary rather than primary resources — highlighting how much of material use still depends on virgin extraction. Most so-called recovered materials are downcycled—crushed into road base, incinerated for energy, or otherwise removed from high-value use. The result? Trees are still cut for lumber, and limestone is still mined for cement. The circular economy, in its current form, is not yet truly circular.

At the same time, material extraction continues to rise. The global economy is now only 7.2% circular, down from 9.1% in 2018, as demand for new materials outpaces recovery efforts. In the EU, material recovery rates

remain far from acceptable, while over 92.8% of materials are either wasted, lost, or locked into buildings and infrastructure, making them unavailable for reuse.

The Netherlands alone has an estimated 7.5 to 10 billion tons of material embedded in its built environment. If circularity is to move beyond an ambition, this vast pool of resources must be treated as precious materials to be maintained and to be cared for. The question is then how we can systematically shift towards doing so.

➤ The Biobased Savior?

Timber and other biobased materials are often framed as the future of sustainable construction. The Netherlands has set an ambitious goal to use wood in 20% of new housing by 2030, positioning it as a climate-friendly alternative to steel and concrete.

While biobased materials can significantly reduce embodied carbon, they are not an unlimited resource. Trees take decades to grow, and large-scale timber production competes with other land uses—forestry, agriculture, and urban development. Expanding timber production requires careful planning: what land is allocated for growing trees, and at what ecological cost?

Furthermore, the climate benefit of timber construction is only realized if buildings remain in use long enough. If wood-based structures are demolished or incinerated prematurely, the stored carbon is rapidly re-released, negating any climate advantage. A timber building sourced from old-growth forests can generate similar, if not higher, emissions than a typical concrete structure over its full life cycle, when this one is short.

Additionally, the current production of biobased materials—including hemp, straw, and timber—often relies on monoculture farming and intensive land use, which can degrade biodiversity and soil health. Without strict material stewardship, biobased construction risks replicating the same extractive logic as traditional materials.

Biobased materials must complement, not replace, a truly circular strategy—one that extends the life of existing structures, reuses materials wherever possible, and treats all resources as finite and valuable.

➤ Beyond Materials

The shift toward sustainable construction is not just about replacing one material with another—it is about fundamentally reorganizing how we build and maintain materials. A truly sustainable approach must combine restraint in new resource use with care for what has already been made.

Rather than viewing demolition as inevitable, we need to treat existing buildings as material valuables. The Netherlands alone holds 7.5 to 10 billion tons of material stock embedded in its built environment—a massive inherited landscape of valuables. While it is imperative to think of deconstruction as a solution of last resort, reusing these resources by deconstruction should be seen as the default strategy, with new (biobased) materials filling gaps only where necessary.

To succeed, we must develop new capabilities in disassembly, storage, and processing, along with tracking systems that enable materials to be reused at scale. What constitute buildings can and must be designed for near infinite lifespans, full adaptability, and easy deconstruction, ensuring that materials retain their value over time. This requires rethinking the entire lifecycle of materials. We must build infrastructures not just for construction, but for circular logistics and material stewardship.

The challenge ahead is not just about material choices—timber versus concrete. It is about supporting a culture where everything already crafted, manufactured, built today can remain so for as long as possible, if not in the form of buildings, in bits and pieces.

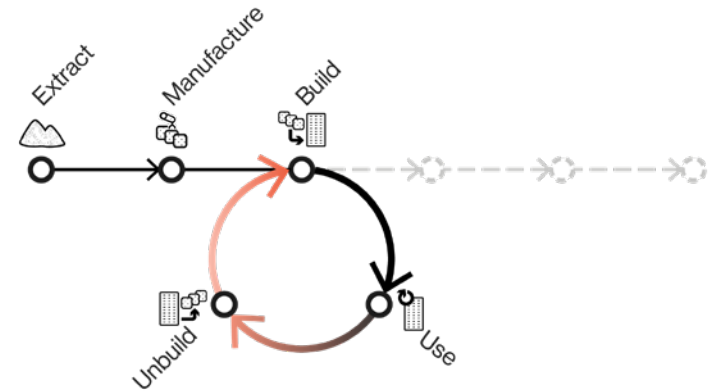


Fig. 9. From circular building in the future reuse...

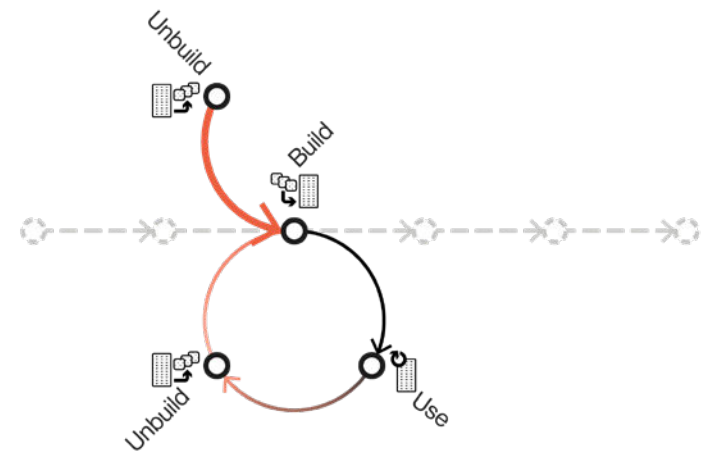
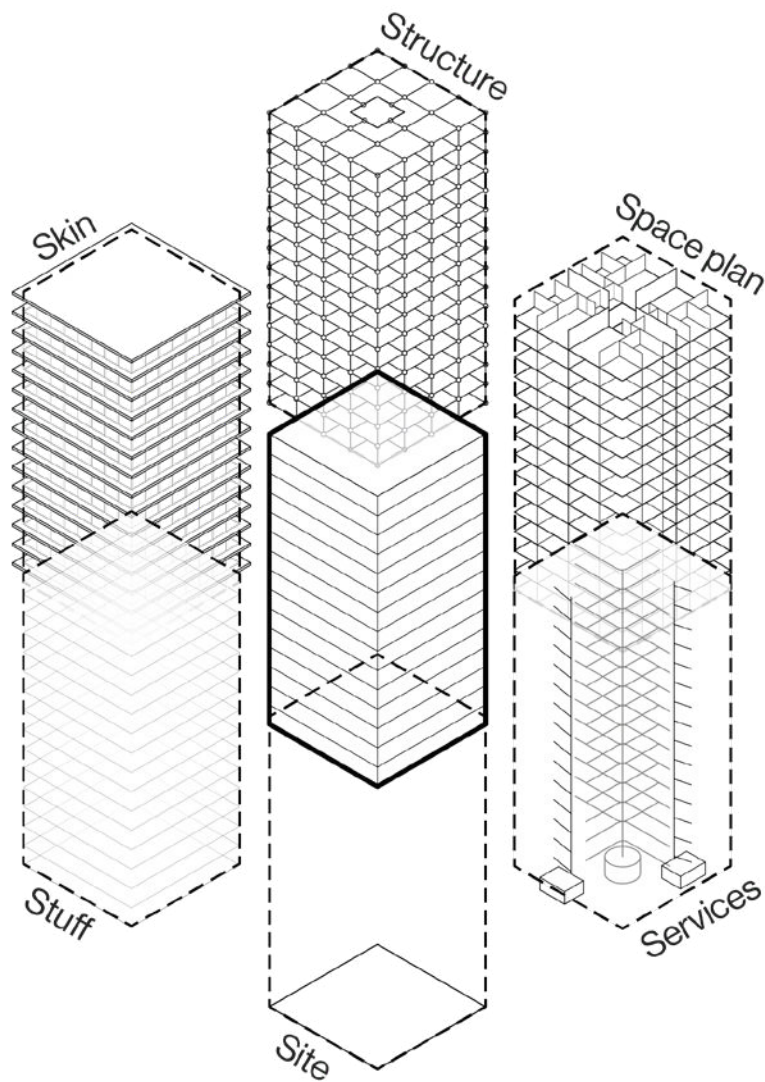


Fig. 10. ... to the building made of reused components.



1.3 Rethink Structures

➤ Buildings Are Not One Thing

A building is not a single, solid object. That is the fundamental error in how we talk about them, legislate them, finance them, and ultimately demolish them.

Buildings are assemblages, layered systems of different speeds, different supply chains, different material, and financial realities. They do not age uniformly. They do not fail uniformly. And yet, we insist on treating them as monolithic wholes, tearing them down in their entirety when only a fraction has reached decay, which definition can be debated at length.

Stewart Brand, in his 1994's *How Buildings Learn* book, expanded architect Frank Duffy's idea of Shearing Layers—a way of seeing buildings composed of overlapping systems that shift and evolve at different rates. The site is permanent, the structure might last a century, but services, facades, and interiors churn through constant change. Every layer has its own failure mode, its own economic logic, its own infrastructure and supply chain.

And yet, we build as if all these layers are one and the same, locking together the permanent and the transient in ways that make adaptation costly and reuse near impossible.

So, we waste materials. Not because we have to, but because we understand buildings fail all at once. To move beyond this, we need to work with each building layer on its own terms—its own logic, its own rhythm of change.

Fig. 11. Steward Brand's shearing layers

➤ Structural structures

If circularity is to mean anything—beyond gestures, beyond materials swapped in and out of the same wasteful logic—then it must start with structure.

The structure of a building is its most carbon-intensive element. The most expensive to fabricate. The hardest to transport. And yet, the most casually discarded because of being notoriously hard to deal with. We replace entire buildings because the floorplans do not fit the next leaseholder’s needs, or because energy codes have changed, or—more often than not—because the economics of land creates new opportunities for real estate operations. Not because the structure itself has failed.

A building’s structure is its biggest investment in material, carbon, and labor. It is also the most challenging to replace. If circularity is to be meaningful, it must start here—in the refusal to needlessly destroy the longest-lasting component of a building. So how can we design care for these valuable materials?

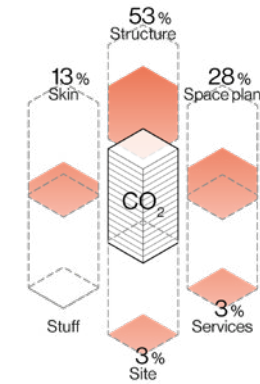


Fig. 14. Weight distribution

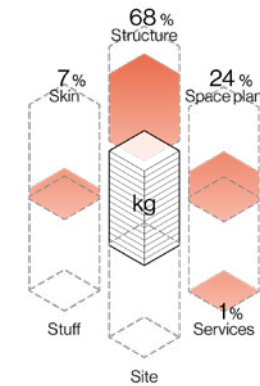


Fig. 12. Embodied CO₂ distribution

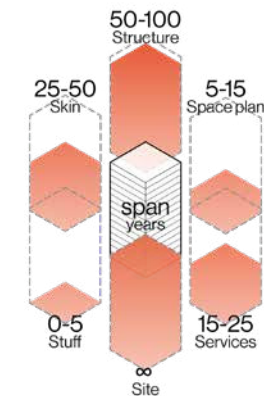


Fig. 13. Lifespan distribution

➤ Deconstructed, stored, then plan?

A notable inspiration for Rebuilt Building is the renovation of De Nederlandsche Bank's (DNB) head office in Amsterdam—or yet to be Rebuilt we should say. As part of this re-development project, the round tower known as 'De Satelliet' was acquired by the forward thinking real-estate developer RE:Born, but not as a traditional building purchase on its site and rather as a material purchase of all of what it is made of. It was then carefully dismantled, with its materials transported by electric boat to a storage facility in Amsterdam-Noord. You can now visit this storage space with all the building components laid out on the floor, much like a Lego kit. These components have been stored for over five years, awaiting reuse in future developments.

This approach involves significant risks for developers, including the financial burden of owning and storing large quantities of materials without immediate application, and the challenge of designing new structures based on the specific characteristics of these reclaimed components. Additionally, securing suitable land that aligns with both the design requirements and the stored materials adds another layer of complexity to the process.

While this experiment shows how far a single project can push the boundaries of reuse, its conditions remain closer to the exception than the rule. It offers a powerful prototype—one that exposes the frictions of ownership, logistics, and design when working with reclaimed components—but it also reveals the limits of waiting for individual buildings to be dismantled, shipped, and eventually reassembled elsewhere. Such case-by-case strategies cannot by themselves guarantee the preservation of what is already standing, nor can they secure a steady flow of useful resources that remain in circulation rather than in storage.

If one wishes to Rebuild Buildings at scale and at speed, we must think beyond the one-off initiatives, however inspiring, waiting for a building to be deconstructed and stored, to then be re-developed, rep-planned, and re-constructed.

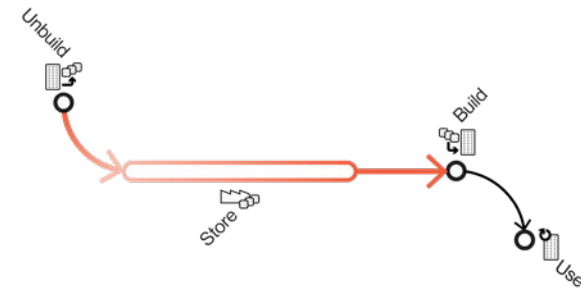


Fig. 15. Lifespan distribution

➤ Timing is everything

What the DNB project ultimately highlights is not just the ingenuity of a one-off experiment, but the deeper question of timing of the circular economy. The act of dismantling, storing, and eventually reusing components exposes a fundamental mismatch between how construction is traditionally timed—predictable, standardized, and supply-driven—and how reuse unfolds—contingent, irregular, and uncertain availability of materials. To move from isolated prototypes to systemic practice, we need to confront this question of timing as an emerging parameter of design.

The construction of any building is based on a strong supply chain infrastructure and network of material providers. Buildings are often conceived with off-the-shelf materials and components, looking at the many catalogs of steel profiles or wood sections. In these conditions, designing buildings is a balance between what the market is used to deliver at scale—meaning economical—and what the designer is specifying to respond to the singularities of this one project—meaning particular. Structures can be made of a whole array of widely available steel profiles, prefabricated concrete columns, or even cast in-situ beams.

Unlike supply chains for new materials which can promise exact specifications and on-demand delivery, the pool of available reused materials is constantly shifting, dictated by what is being deconstructed around the site of the new construction. Timing is what makes constructing buildings entirely out of re-used elements a challenge, especially for structural components.

How do you conceive buildings structures when what it can be made of today might not be available tomorrow?

This calls for construction models that can work with reused elements coming from multiple sources, each arriving with its own timing, dimensions, and specifications. Instead of depending on the dismantling of a single building, projects would draw from a distributed pool of components, reducing vulnerability to delays or shortages and ensuring that more materials remain in active use. By weaving together these fragmented flows, reuse shifts from isolated experiments to a more resilient, systemic practice. Dynamic material supply demands a renewed logic of building fit for reuse—one that must navigate uncertainty, impermanence, and evolving material flows.

In this new context, we need to think beyond established processes. How do we align the timeline of a construction project with the unpredictable cycles of material availability? How can we plan adaptive buildings where every beam, column, and slab have a different history? These are not just technical questions but also systemic design challenges. They require a fundamental shift in how we plan, organize, and construct buildings.

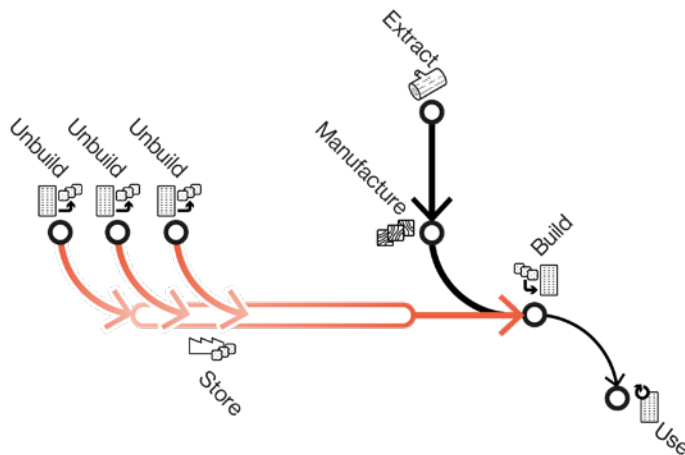


Fig. 16. The making of one building out of many

Rebuilt Buildings is not just about designing a building. It is about redesigning the question itself—challenging the assumptions, processes, and economic structures that define architecture today. Rebuilt Buildings is the exercise in designing a circular building, but more importantly, an exploration into the infrastructure, logistics, governance, and economies necessary to sustain large-scale material reuse.

1.4 What's the question?

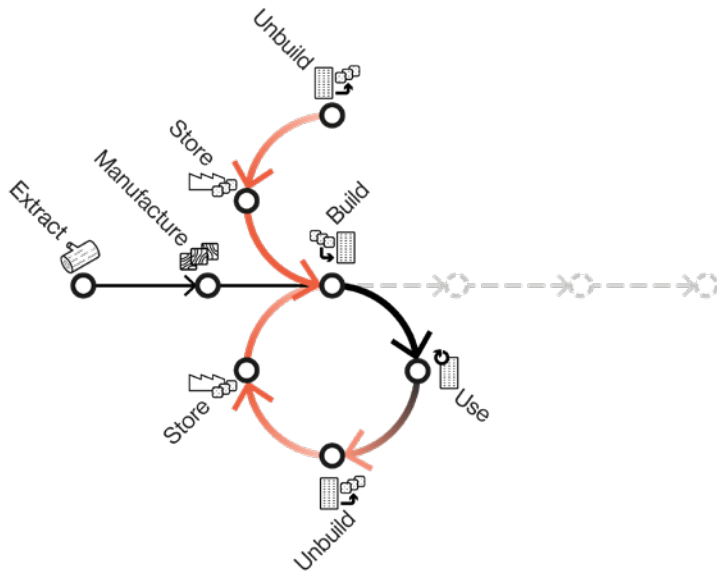


Fig. 17. Rebuilt Buildings material logic

➤ The Question is the Project

Rebuilt Buildings is not simply about the design of one building. It is about reopening the question of how we build at all—testing the assumptions, processes, and economic habits that underpin construction today. The project begins with the design of a circular building, but its real work lies in probing the infrastructures, logistics, governance, and economies that could allow material reuse to operate at scale.

If circularity is to move beyond incremental improvements, beyond swapping one material for another within the same wasteful logic, then the real challenge is not just how to reuse materials, but how to embed reuse within the design, development, and economic systems that shape buildings long before they are constructed.

Framing the question as the project shifts design from problem-solving to problem-setting. It recognizes that the most pertinent task is not to deliver a singular solution, but to question the systemic conditions that make solutions possible, how materials are valued, how risks are distributed, how flows of matter, money, and authority are organized. In this sense, the project is less a prototype of a building than a prototype of a different way to build.

“To describe the problem is part of the solution.” (Karl Gerstner, 1964)

➤ A Microcosm of an Industry

A circular construction ecosystem depends on the people who hold it together. In conventional projects, roles tend to be fixed and separate. In a new operating logic of construction, roles are emerging as the exploration advances. Rebuilt Buildings asks demolition crews, storage managers, engineers, designers, and developers to work as one chain. What emerges is less a conventional project organization than a reconfigured supply network, where barriers are dismantled and expertise flows across stages that are usually kept apart.

The project brings together actors who usually interact only when briefs are defined and are hard to be questioned—demolition experts, architects, engineers, logistics specialists, and real estate developers—into a single continuous loop, where material availability reshapes design, engineering informs deconstruction, and financial models account for new material realities.

→ **Superworld**

(Architect & System Designer)

Develops adaptive architectural frameworks integrating reclaimed materials, designing systems responsive to available stock rather than fixed specifications.

→ **Urban Miner**

(Demolition Contractor & Logistics) Identifies, salvages, and prepares high-quality reclaimed building components, maximizing their value for reuse.

→ **Summum Engineering**

(Structural Engineer)

Ensures structural viability by applying parametric design tools that adapt new constructions to existing components dimensions.

→ **C'MON**

(Real Estate Developer & Circular Business Strategist)

Designs circular business models and real estate strategies, translating reuse methodologies into financially viable and scalable projects.

→ **DGMR**

(Process Supervisor & Circular Economy Specialist)

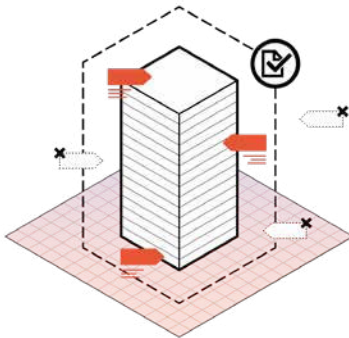
Oversees circular construction processes, ensuring compliance with regulatory standards, environmental assessments, and certification protocols.

By designing a building structure from reclaimed component, the process aims to navigate systemic barrier that currently prevents circular construction from becoming mainstream. Conceiving a building as an excuse to discover what does it mean to build anew from what is already existing today.

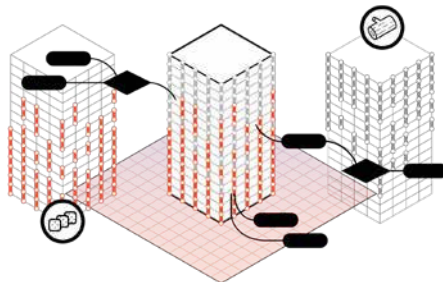
➤ Learning the how, through the what!

Rebuilt Buildings is not just a thought experiment. Through the concept of a single building, we collectively explore every stage of the process: material sourcing, logistics, planning, regulatory constraints, and financial feasibility.

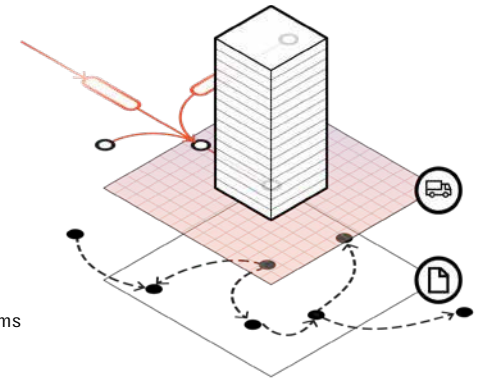
① The building brief Defining the navigation tool to guide the exploration of Rebuilding a Building



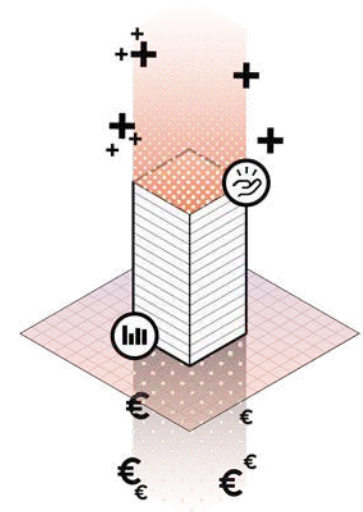
② Form follows availability Designing reclaimed buildings in a world of ever-shifting materials



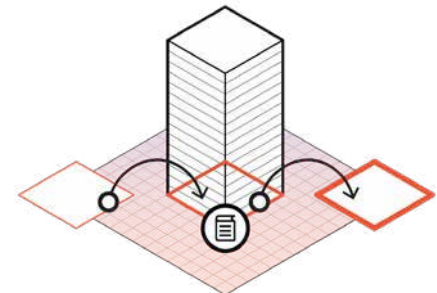
③ The Flow, the Wait, the Bureaucracy Exploring the administrative and logistical circular systems



④ Value: Economics and beyond Defining costs and accounting values



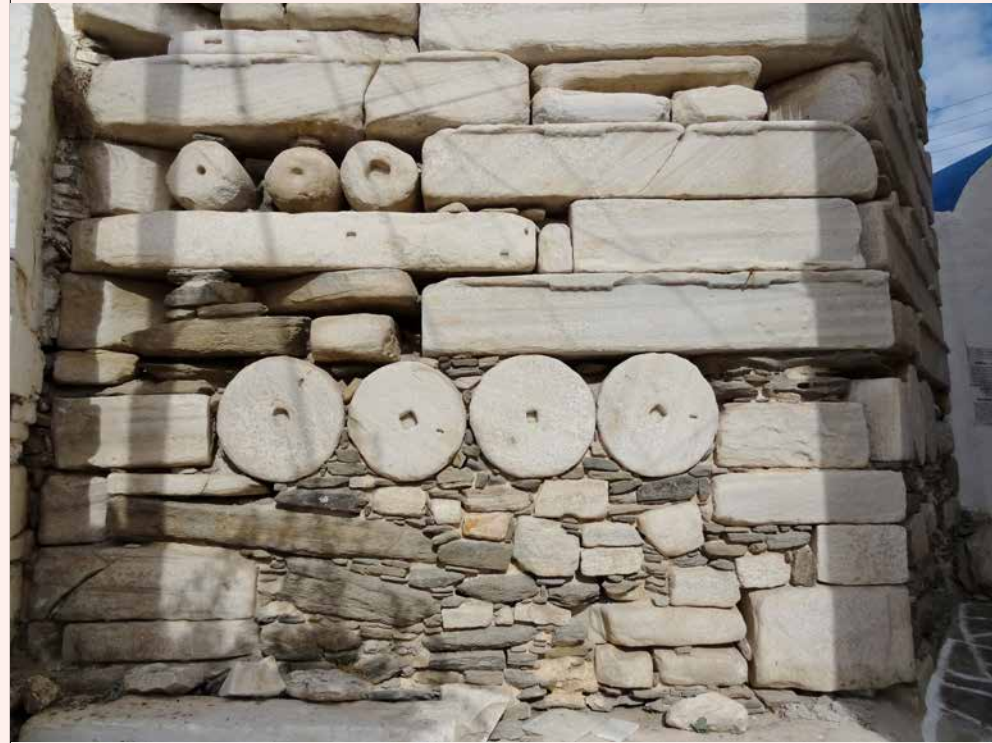
⑤ Situating knowledge Learning from others, and sharing findings in a wider context



The context of Rebuilt Buildings

Spolia (noun / spo-lia): the reuse of architectural elements or decorative materials from an older structure in a new construction, for pragmatic reason to save labour or materials, or for ideological meaning.

Scarcity once called the shots, when local supply ran thin materials were prized and reassembled



Castle of Parikia, Parikia, Greece, 1260
CC BY-SA 4.0, Warren LeMay

At times, seized marbles from conquered land became early brand strategy, casting power in ornaments



St. Mark's Basilica, Venice, Italy, 1063
← CC BY-NC-SA 2.0, Steven Zucker
↑ CC BY 2.0, Tony Hisgett



Handled with care heterogeneity becomes a design feature, a collage born of recycling beauty

Mosque-Cathedral of Córdoba, Córdoba, Spain, 1236
CC BY 2.0, Richard Mortel



Today dismantled beams live in warehouse spreadsheets, inventory is the new quarry



The Satellite, De Nederlandsche Bank RE:BORN ontwikkeling, Amsterdam, The Netherlands, 2020
RE:BORN

This forces us to rewrite a bureaucracy built for a linear economy, from value rules to insurance tables



K119 – baubüro in situ, Winterthur, Switzerland, 2021
Martin Zeller



Materials on wheels remind us that permanent is just an accounting stance

People's Pavilion – Bureau SLA + Overtreders W, Eindhoven, The Netherlands, 2017
Filip Dujardin



Every piece carries a future, ready to assemble the next Rebuilt Building



Tijdelijke Rechtbank – Cepezed architecten, Amsterdam, The Netherlands, 2022
Cepezed, Lucas van der Wee

2

How to Rebuild a Building?

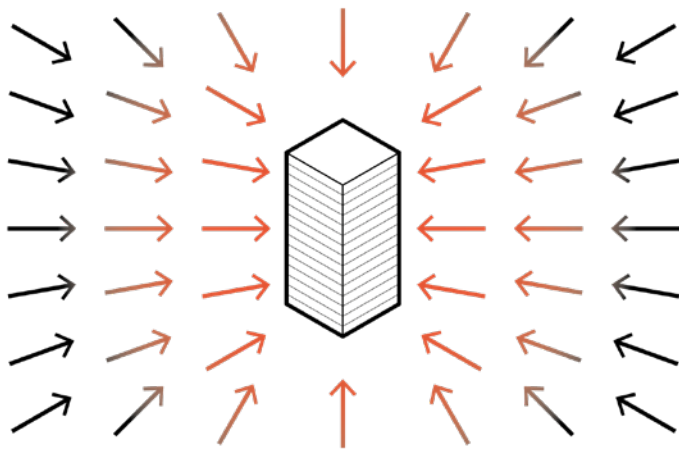


Fig. 18. Designing a building as an excuse

2.1 The building brief

➤ The plot

In a project about designing innovation, the storyline is complex, fuzzy, and mostly open ended. It becomes then crucial to define a general direction, a framing, keeping research, design, and conversations relevant in the aggregate. Here enters, the MacGuffin.

Alfred Hitchcock popularized the term MacGuffin in cinema—a plot device that propels the narrative forward but is, in the grand scheme, almost irrelevant. The briefcase in *Pulp Fiction*, the microfilm in *North by Northwest*, the glowing suitcase in *Ronin*—each is an object that drives the characters' decisions, but the actual contents matter far less than the story it enables.

Dan Hill translated this idea into strategic design: sometimes, the thing we are designing is not the real goal—it is simply the catalyst for something bigger. In *Rebuilt Buildings*, the project might seem to be about constructing a single circular building, but that is just the MacGuffin.

What truly matters is the process, the networks, the logistics, and the systemic shifts that designing such a building necessitates. The building itself? Simply the plot device.

➤ The brief

Almost every building starts with a brief. And a traditional building brief is rather prescriptive. It outlines programmatic needs, spatial requirements, material specifications, budget, timeline—all driven by an assumption of predictability. The logic is simple: we define what is needed, we design a solution, then source the materials to match.

If a conventional building brief is a predefined script, the Rebuilt Buildings brief is an improv jazz session that evolves as it is being played. It has a starting structure as well as a set of guiding principles, but it must adapt as new constraints and opportunities emerge. Although, the brief gives a clear direction and boundaries, even if adaptive, what is relevant to the overall story, and what is secondary and can be explored another time, another place.

Rebuilt Building, however, operates in an exploratory logic. The designed building brief is both leading and following.

To make this work in practice, the team works in a constant feedback loop between the building brief as a given—based on existing ways we build today—as an opportunity to be designed differently—aiming for alternative ways to build. The project operates in dialogue with conventional and ideal, between known and unknown, to be tackled and to be continued.

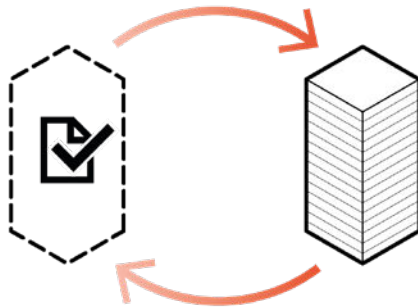


Fig. 19. A brief that leads by following

The final building—whatever it becomes—is just the MacGuffin. The real success of the project will be measured not by the object itself, but by the systems it questions and the alternative it fleshes out.

The brief, then, is not a destination. It is a tool for navigation—a way of making sure that, in all the complexity, in all the shifting timelines and material flows, we explore what are the system implications of circular construction through the applied explorations of:

How to Rebuild a Building?

Rebuilt Building – The building brief

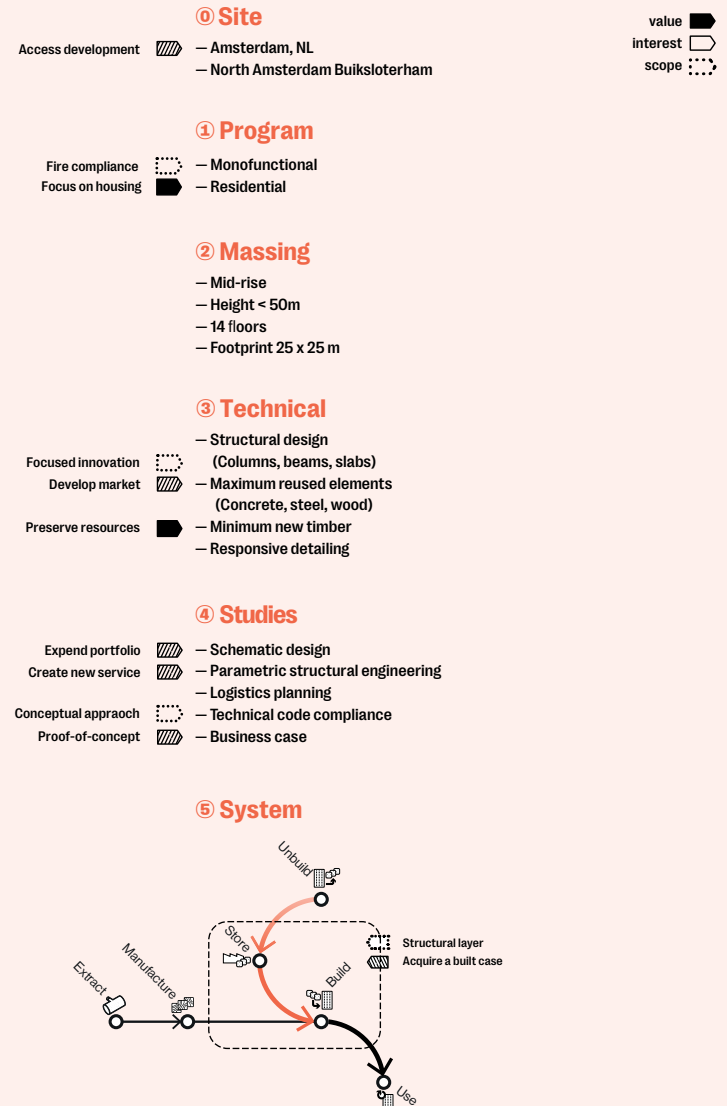


Fig. 20. Defining emerging design boundaries

Situating knowledge – In conversation with Menno Rubbens from cepezed about the Tijdelijke Rechtbank

The Tijdelijke Rechtbank, or Temporary Courthouse, is a justice building designed to be built, dismantled, stored, and rebuilt. Cepezed’s kit-of-parts approach – dry connections, mapped components, and full material passports – turned the logistical and administrative complexity of unbuilding into a workable process.

The courthouse served five years on Parnassusweg and was conceived from the outset to leave intact. After decommissioning, it moved into storage while a second life is arranged. This trajectory differs from Rebuilt Buildings, which works with irregular stock already in circulation. In this case, the components were fabricated for planned reuse within the same system. Yet the demonstration is valuable: a full structure can be dismantled, transported, stored, and reassembled without losing performance or traceability.

The project also clarifies how to organise the chain. Detailed documentation shortens certification cycles and reduces frictions in relocation. Here, the developer who owns the materials and the architect who designed them are part of the same organisation. That alignment closes feedback loops and concentrates the ability to



Fig. 21. Temporary Courthouse, built to be demounted. © Lucas van der Wee

take risk. The contract required the site to be vacated, with all materials removed, after five years. This created a countdown: the longer stock remains in storage, the weaker the business case becomes. The counterweight is residual value. When components stay intact and verifiable, their worth carries forward as a tangible line in the model rather than a narrative claim.



Fig. 22. © Lucas van der Wee

Name	Tijdelijke Rechtbank Amsterdam
Location	1st life: Amsterdam 2nd life: Twente
Years	1st life: 2016–2021 2nd life: 2025–...
Program	1st life: Courthouse 2nd life: Offices
Size	5,400 m ²
Reuse intent	Temporary building to be demounted, transported, stored, and reconstructed
Reuse strategy	Full kit-of-parts, dry connections, documented inventory for reassembly, residual value of material

2.2 Form follows availability

The logic of conventional architecture is one of predictability—a process designed around certainty, precision, and repeatability. The system assumes materials are available in all shapes, forms, and dimensions. Materials are ordered to precise specifications, components arrive just-in-time, structures are assembled as planned.

But in a world of reuse, these assumptions are challenged. Material flows are unpredictable. Stock fluctuates. A steel beam that is on the market today might be gone tomorrow. This forces a fundamental shift in design logic. Instead of trying to force sourcing materials from a variable supply for a fixed building design, form must follow availability. Rebuilt Building is about adapting the processes of designing a building in a system that can adapt to whatever materials are at hand.

It is not about making reuse fit into conventional construction logic, but about rethinking construction to fit the logic of reuse. Then, the question is no longer what do we want to build, but rather, how can we build adaptively with what is available?

If form was once a response to function, in a circular economy, form follows availability.

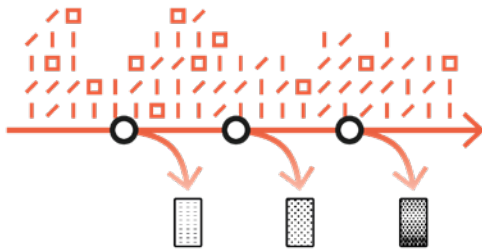


Fig. 23. Forms follows availability

➤ Structuring the structure

To consider Rebuilding a Building starts with considering what is widely available as deconstructed and deconstructable elements in the Netherlands, not just today but also in the future. The structural framework should then allow to accommodate a wide range of what the existing buildings in the country are made of, as well as the possibility to adjust to shifting availability.

A structural framework designed for reuse must accommodate a wide range of existing materials, ensuring flexibility as supply fluctuates. In this study, columns, and beams are the focus, while elements like foundations, slabs and fixed new concrete cores remain outside the immediate scope but would deserve further research.

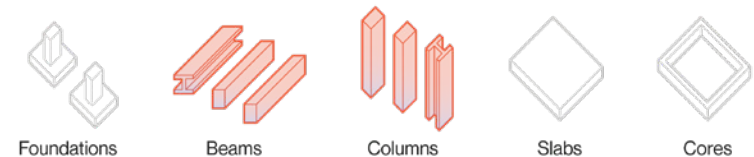


Fig. 24. Focus of the structural system

The resulting system is a simple column-beam framework, integrating reused components wherever possible and complementing them with new timber elements only when necessary. While not being the unique way to Rebuild a Building, this configuration allows for elements to be swapped, based on real-time availability, even at the last minute. An open framework, allowing for change, because change is inevitable.

The structure is conceived as a simple system of columns, beams, and slabs, based on a grid system.

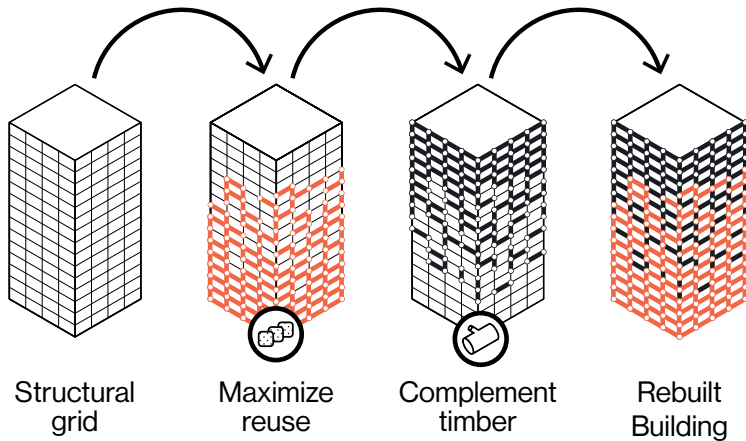


Fig. 25. Maximizing reuse, limiting new materials Maximizing reuse, limiting new materials

Based on this structural strategy, different grid configurations can be considered, each with varying degrees of adaptability. Some prioritize efficiency and repetition, others allow for maximum reuse flexibility, absorbing components of varying sizes and dimensions.

Each system has its own particularities. One system will use many small components with short spans and low strength requirements, while another system will use large variety of components' dimensions and requirements. Depending on the project context, one system might be favored over another.

If anything, this exploratory process shows that How to Rebuild a Building is a process that is contextual, not only in its material or technical contexts, but also technological and practical ones.

➤ Adaptive plans

If the structure adapts during a design process, so must the spaces within it. Traditional buildings are designed with column grids defined by fixed span widths—but what happens when the structure itself is a moving target, when columns are inserted in or eliminated from the grid, based

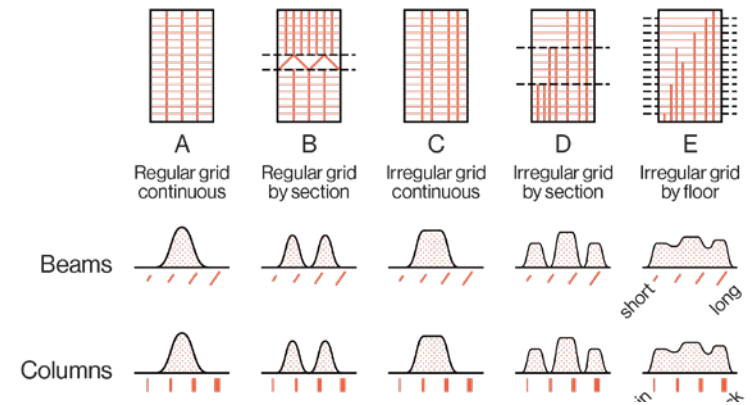


Fig. 26. Structural strategies enabling specific forms of reuse

on the structural capacity of different kinds of reused beams?

Floor plans layouts are designed around structural flexibility. Rooms are not impacted with different structural density depending on what is available. Walls are secondary, responding to the logic of materials rather than dictating it.

To integrate reused structural elements efficiently, the building is organized on a regular 1.50m x 1.50m grid. This spacing strikes a balance between several requirements: it is as a single grid field small enough to accept a wide range of reclaimed components of low load-bearing capacity, yet combination of several structural fields generous enough to satisfy minimum room-width standards and to keep on-site assembly practical.

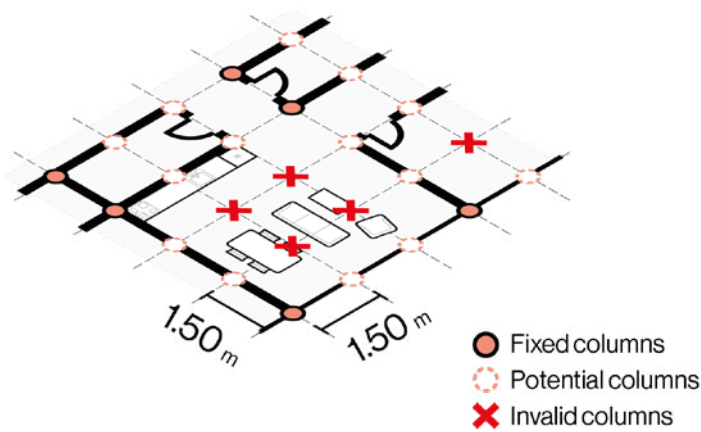


Fig. 27. Designing an adaptive structural system

At every grid intersection one of three conditions is defined:

Fixed columns

a column is always present. Together these provide the baseline support, sized as if the building were a conventional timber-frame structure.

Potential columns

a column may be placed. Activating these positions increases the share of reused material: shorter spans mean that lighter or less-strong reclaimed beams and posts can be employed whenever they are available.

Invalid columns

no column may be placed here because it would render the space unusable (e.g., the center of a corridor or bedroom).

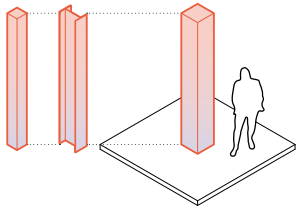
Around every fixed or optional column position a 0.40 m free zone is reserved on all sides. This buffer ensures that variations in the size of reclaimed columns—and element, fire-protection wraps or services that surround them—never obstruct the functionality of the building.

Flexible plan is about ensuring that a constantly shifting material supply does not result in compromised spaces. It is about adapting how buildings are planned in a world of constant material shifts.

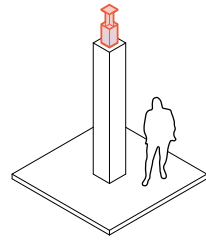
➤ An adaptive connector

A structure assembled from reclaimed elements cannot rely on repetition. Each component arrives with its own dimensions, material behavior, and traces of its previous use. What emerges is a system built for adaptation, a structural language that accommodates variation without compromising integrity.

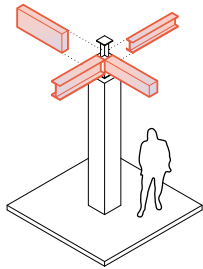
This is made possible by a central design strategy: a flexible node that acts as the meeting point between columns, beams, and slabs. Around it, the building takes form—not from uniform parts, but from a coordinated interaction of mismatched ones. The following breakdown outlines how each element contributes to this system.



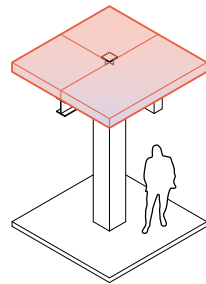
① Columns



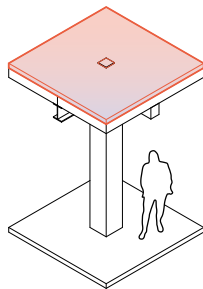
② Connection node



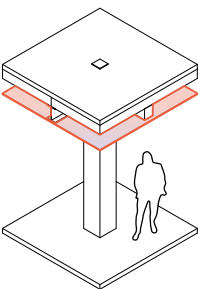
③ Beams



④ Slabs



⑤ Floor build-up



⑥ Ceiling

Fig. 28. How to assemble varying components

① Columns

The building system is a composition of components - starting with a reclaimed column made of concrete, steel, or timber.

② Connection node

To compile individual elements into a structural system, a flexible connector is needed. A steel node is bolted onto columns, designed to connect on up to all four sides to available reused materials.

③ Beams

With the steel node at center, the system can integrate components of different sizes, material, and origin. The steel beam from a former office tower becomes part of the same structure as the concrete bar that held up a housing complex before.

④ Slabs

Reused floor slabs are placed to match the structural grid, with the steel nodes connecting the floor to structure to allow for vertical load distribution throughout floors.

⑤ Floor build-up

The floor build-up completes the surface of the unit and can be flexibly designed according to functional and personal requirements.

⑥ Ceiling

Depending on program, building height and the reused materials used in the structure, a suspended ceiling might be applied for fire safety or regulatory reasons.

➤ Parametric materiality

If the structure and layout of a Rebuilt Building are adaptable, the next layer of complexity is real-time material selection. Unlike conventional buildings, which begin with a spatial and structural design to then procuring materials among infinite pool of manufactured products, a building designed for reuse must continuously negotiate material availability, carbon impact, and logistical feasibility.

The imagined process is iterative and can be framed in a few steps:

Step ①

First, material sourcing happens across multiple scales. Local material storage hubs provide the most reliable data—components are verified, categorized, and readily available. Online platforms function as decentralized marketplaces, expanding the selection but with less predictability. Building donors, identified through planned demolitions nearby, push reuse further by integrating materials that are not yet in circulation.

Step ②

Second, the structural strategy is chosen according to the available reused components, among the different grid options considered. The structure is not predefined. Parametric design allows for an architecture that responds to what exists, rather than demanding what does not.

Step ③

Third, a script approach turns real-time available components into structural design through optimization loops. For every beam or column, the script applies a strict hierarchy. It first seeks identical reclaimed elements available. If no match is found it accepts a sub-optimal element. The goal is to maximize the use of existing materials in their largest possible dimensions, avoiding unnecessary cutting that would reduce their future reuse. Then, only as a last resort, the script allocates virgin timber element. The optimization loop is then triggered testing if different optional columns could be placed to augment the number of reused elements that could be inserted. After each loop, the algorithm records two core metrics—the percentage of reclaimed supply incorporated and the ratio of waste and off-cuts to reclaimed material used—and couples them with the total structural weight, a practical proxy for leaner design. These data drive a multi-objective optimization that is replayed across hundreds of grid variants.

The final structure is not a static blueprint but an optimized negotiation between stocks, logistics, and performance—an outcome that could not have been predefined at the start.

The structure emerges from real-time material supply, matching available reclaimed components to structural needs while minimizing waste—as a balance between structural soundness and degree of reuse.

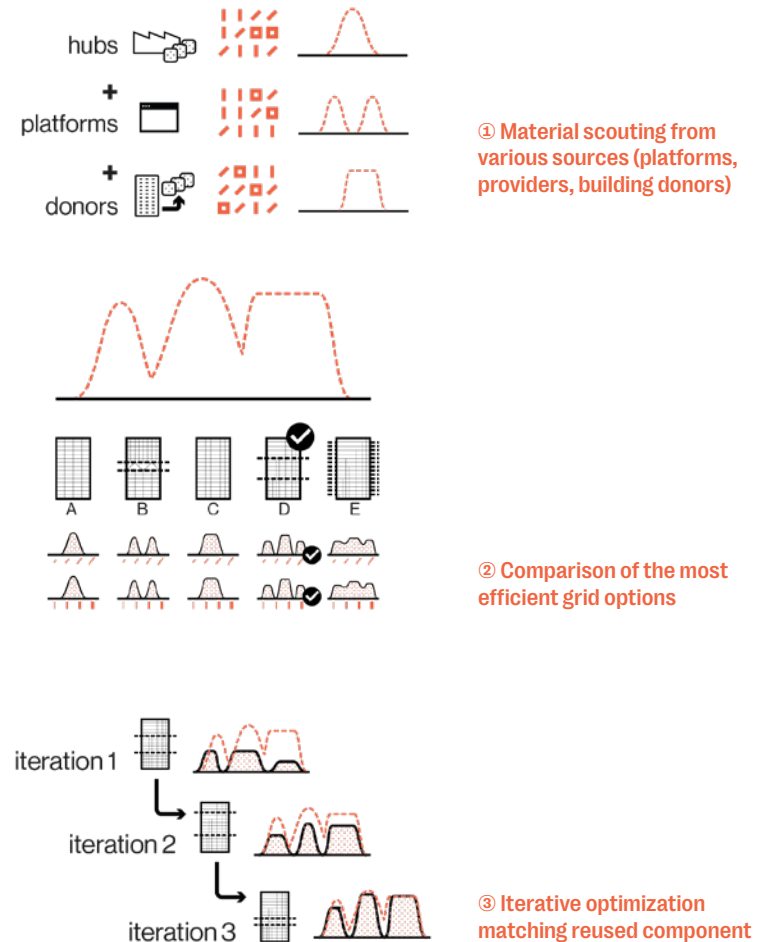


Fig. 29. Sequenced logic of adapting structure to available components

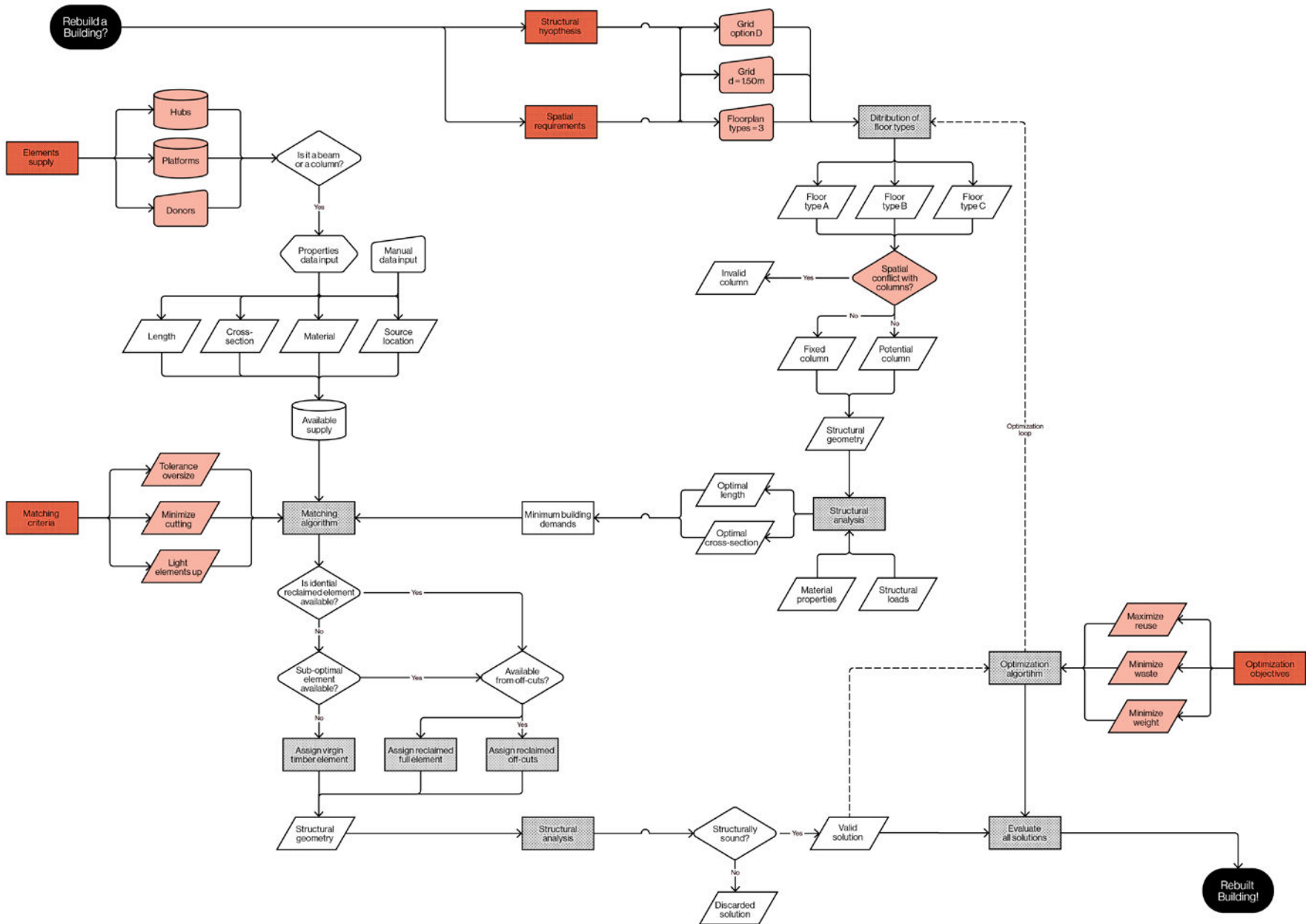


Fig. 30. Decisions logic of the parametric structural design

➤ Exploring out loud

Making the tools behind this process transparent is as important as the outcomes they produce. Sharing methods invites scrutiny, adaptation, and collective progress—especially in a field as emergent as circular construction.

The work on data gathering has been made open-source and is available through a GitHub repository. It already includes snippets of code used to collect and process data from online platforms offering reclaimed building materials.

<https://github.com/SupplyAndDemand>

As part of ongoing research into circular construction at Summum Engineering, additional scripts, utilities, and components that support better access and use of this data will continue to be added. The goal is to make these tools available to anyone, so they can be adapted, improved, and applied more widely, since the value of this work benefits from broad adoption.

➤ In practice

the principles must be assessed in real-time against an actual dataset of available components, as recorded in April 2025.

First step, the process begins with a direct inventory of reclaimed elements from Urban Miner, a hub operating within the demolition and material recovery chain. This is then supplemented by listings from online platforms such as Insert, expanding the available supply to a national scale. Each component is catalogued with its exact dimensions, mechanical properties, and origin. Together, these sources form the basis for the iterative reuse optimisation process.

As an initial assessment, the dataset highlights several key insights. First, when aggregating listings across multiple platforms, many components appear in duplicate. This is often the result of material holders cross-posting their listings to increase visibility. To avoid overcounting, a filtering process is required to identify and remove duplicates. For the Rebuilt Building study, we limited ourselves to a single online marketplace Insert. Second, the available elements show wide variation in dimension, material, and location—underscoring the importance of adaptive design systems that respond to the reality of available

stock. And third, the overall volume of suitable structural components remains modest, confirming that the market for reclaimed elements is still in development. This makes it all the more important to design with flexibility, as selectivity is often a luxury.

To scale the simulation to building level, a set of virtual building donors was introduced. These are hypothetical but plausible contributors to the material stream, used to project the near-future potential of the supply. Their inclusion multiplies the original dataset into a testable volume:

	Reused steel	Reused concrete	
Hub Urban Miner	0	72	components
Platform Insert	371	0	components
Donors virtual	1040	128	components
Sub-total	1411	200	components
Total elements	1611		components

Fig. 31. Sources of reused components for the Rebuilt Building

"We have to learn to design from the materials that are already there, not from a blank sheet of paper."

Jan Jongert, Superuse

Source	Type	Material	Profile	L(cm)	A(cm ²)	D (h/N/m ²)	W (kg)	EE(M ³)	Amount
Hub	Column	Reclaimed concrete	C_20x30	270	600	25	406	203	7
			C_20x30	470	600	25	706	353	8
			C_30x30	270	900	25	608	304	26
			C_30x30	470	900	25	1058	529	4
			C_40x40	470	1600	25	1880	940	1
			C_50x50	270	2500	25	1687	844	17
			C_50x50	470	2500	25	2936	1469	9
			C_50x60	470	3600	25	4250	2125	2
			HEA100	270	21	79	45	226	98
			HEA100	470	21	79	78	390	25
		HEA120	270	25	79	54	270	43	
		HEA140	270	31	79	67	336	16	
		HEA160	270	39	79	82	410	7	
		HEA180	270	45	79	96	480	10	
		HEA200	270	54	79	114	570	19	
		HEA220	470	54	79	199	995	11	
		HEA220	270	64	79	136	680	17	
		HEA240	470	64	79	237	1185	2	
		HEA240	270	77	79	163	815	9	
		HEA260	470	77	79	284	1420	2	
HEA260	270	87	79	184	920	6			
HEA360	270	143	79	303	1515	4			
HEA360	470	143	79	527	2636	1			
HEB260	270	118	79	251	1256	1			
HEB340	270	171	79	362	1810	1			
IPE 190	470	24	79	88	440	10			
IPE 220	270	33	79	71	355	10			
IPE 240	270	39	79	83	415	24			
IPE 400	270	84	79	178	895	9			
IPE 190	450	20	79	71	355	3			
IPE 220	600	33	79	87	785	2			
IPE 240	450	39	79	138	690	2			
IPE 300	600	54	79	253	1265	1			
HEA100	270	21	79	45	226	43			
HEA120	270	25	79	54	270	21			
HEA140	270	31	79	67	336	2			
HEA160	270	39	79	82	410	14			
HEA180	270	45	79	96	480	19			
HEA200	270	54	79	114	570	43			
HEA220	470	54	79	199	995	9			
HEA220	270	64	79	136	680	21			
HEA240	470	64	79	237	1185	8			
HEA240	270	77	79	163	815	27			
HEA260	470	77	79	284	1420	3			
HEA260	270	87	79	184	920	12			
HEA360	270	143	79	303	1515	15			
HEA360	470	143	79	527	2636	2			
HEB260	270	118	79	251	1256	2			
HEB340	270	171	79	362	1810	2			
IPE 190	470	24	79	88	440	2			
IPE 220	270	33	79	71	355	12			
IPE 240	470	39	79	138	690	6			
C_20x30	270	600	25	406	203	12			
C_20x30	470	600	25	706	353	6			
C_30x30	270	900	25	607	304	10			
C_30x30	470	900	25	1058	529	30			
HEA100	150	21	79	25	125	444			
HEA100	300	21	79	50	250	40			
HEA120	450	21	79	75	375	47			
HEA120	600	21	79	100	500	2			
HEA140	150	25	79	30	150	6			
HEA140	300	25	79	60	300	51			
HEA160	450	25	79	90	450	24			
HEA180	300	31	79	74	370	9			
HEA200	450	31	79	111	555	25			
HEA220	450	39	79	138	690	14			
HEA240	600	54	79	284	1420	66			
HEA240	450	64	79	227	1135	9			
IPE 190	450	20	79	71	355	6			
IPE 220	600	33	79	87	785	13			
IPE 240	600	39	79	184	920	42			
IPE 240	600	600	25	900	450	20			
C_20x30	450	600	25	675	338	8			
C_30x30	600	900	25	1350	675	42			
T_10x30	450	300	5	68	408	92			
T_12.5x40	600	300	5	90	540	20			
T_12.5x40	450	500	5	113	678	30			
T_25x25	600	500	5	150	900	16			
T_25x25	450	625	5	141	846	29			
T_25x25	600	625	5	188	1128	8			

Fig. 32. Catalogue of components used in the Rebuilt Building

Second step, with the dataset defined, the next step was to select the structural strategy. For the Rebuilt Building, grid option D was retained for further development. It balances adaptability with constructability—bold enough to innovate, grounded enough to execute.

Third step, the iterative optimization script is applied matching reused component with structural design. The optimization uses three objectives: maximizing the use of reclaimed beams, minimizing waste relative to the used supply, and minimizing total structural weight to promote leaner designs. In this multi-objective optimization, the selected solution lies on the Pareto front and was chosen for its well-balanced trade-off between these objectives. While it does not outperform the extreme solutions in either reuse or waste efficiency individually, it achieves a smart compromise that avoids the severe downsides of both.

	Most columns	Concrete	Least columns
Compositions of structural components			
Reused steel	34%	73%	77%
Reused concrete	11%	14%	10%
Virgin timber	55%	13%	13%
Reused ration	45%	87%	87%
Supply used	20%	24%	19%
Waste efficiency	0.36	0.19	0.27

Fig. 33. Selection of a structural design that balances material interests

The selected solution doesn't use the absolute maximum amount of reclaimed material—but it comes close. It uses about 11% less reclaimed supply than the best-performing reuse option. However, that reuse-maximising option creates a lot more waste—over 38% more than the selected one. On the flip side, the most waste-efficient solution only reduces waste by 1% compared to the selected one, but it also uses 8% less reclaimed material. In other words, the chosen solution strikes a smart balance—very high reuse, very low waste.

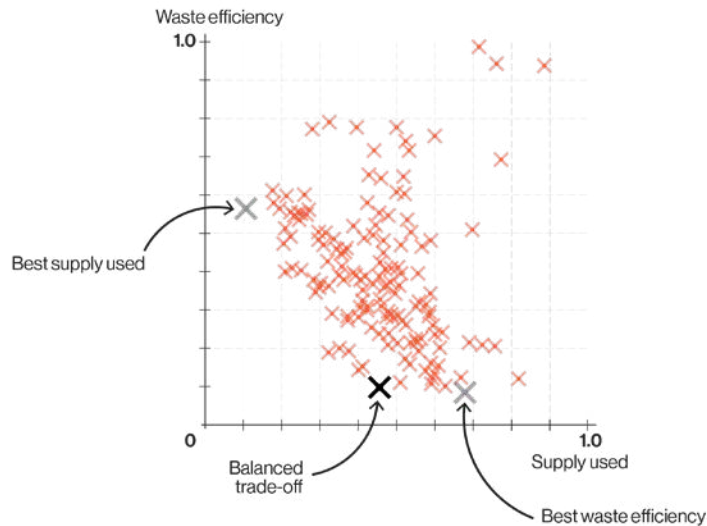
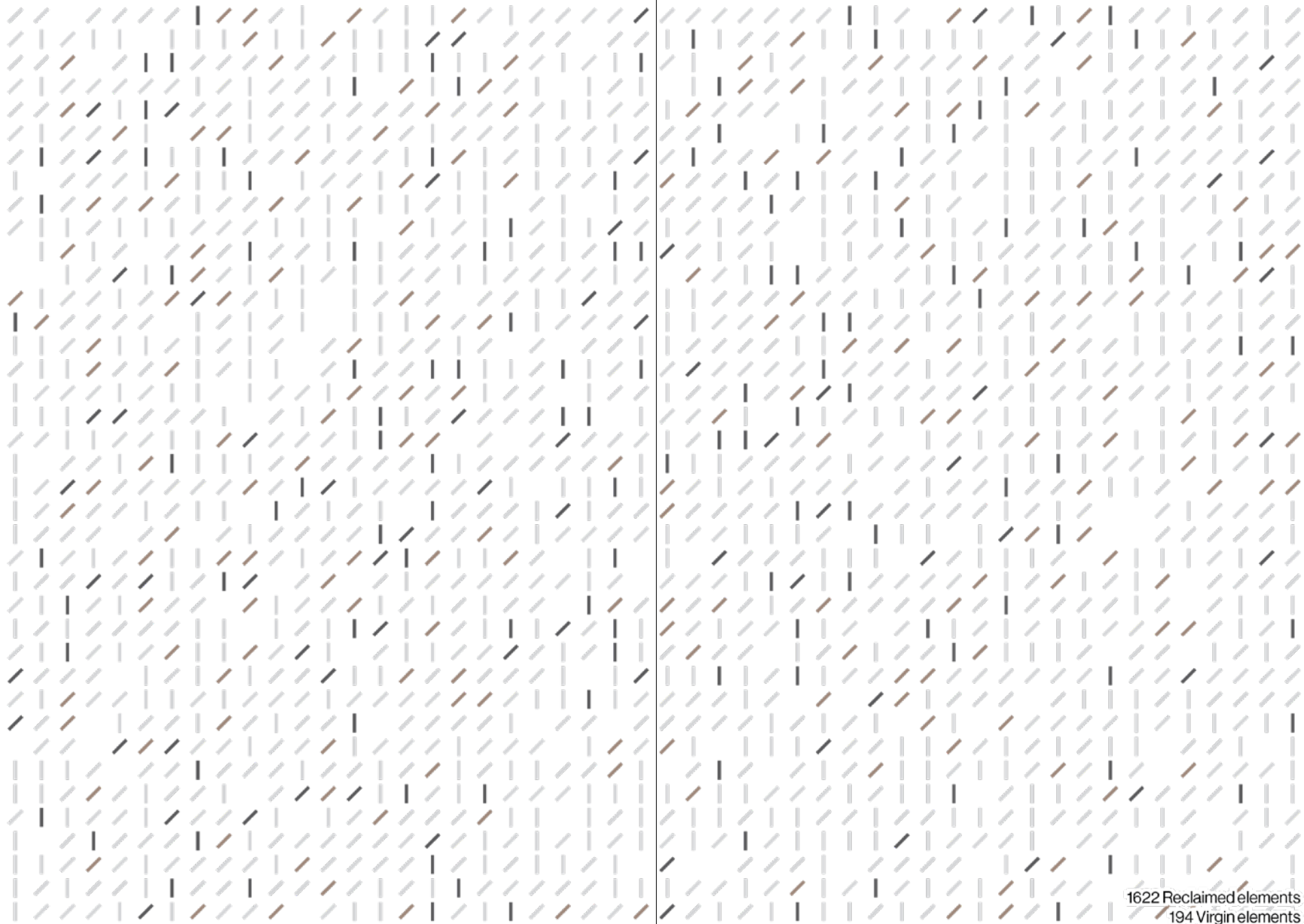


Fig. 34. Distribution of waste to degree of reuse for different structural design

This real-time negotiation between material and form results in a structural composition that is entirely unique, shaped by the availability of components at that specific moment. It will look tomorrow differently than it does today. The outcome is not just a prototype but a proof-of-concept — a built demonstration of a Rebuilt Building.



Legend

All structural elements in the Rebuilt Building

Fig. 35. All components used for the Rebuilt Building

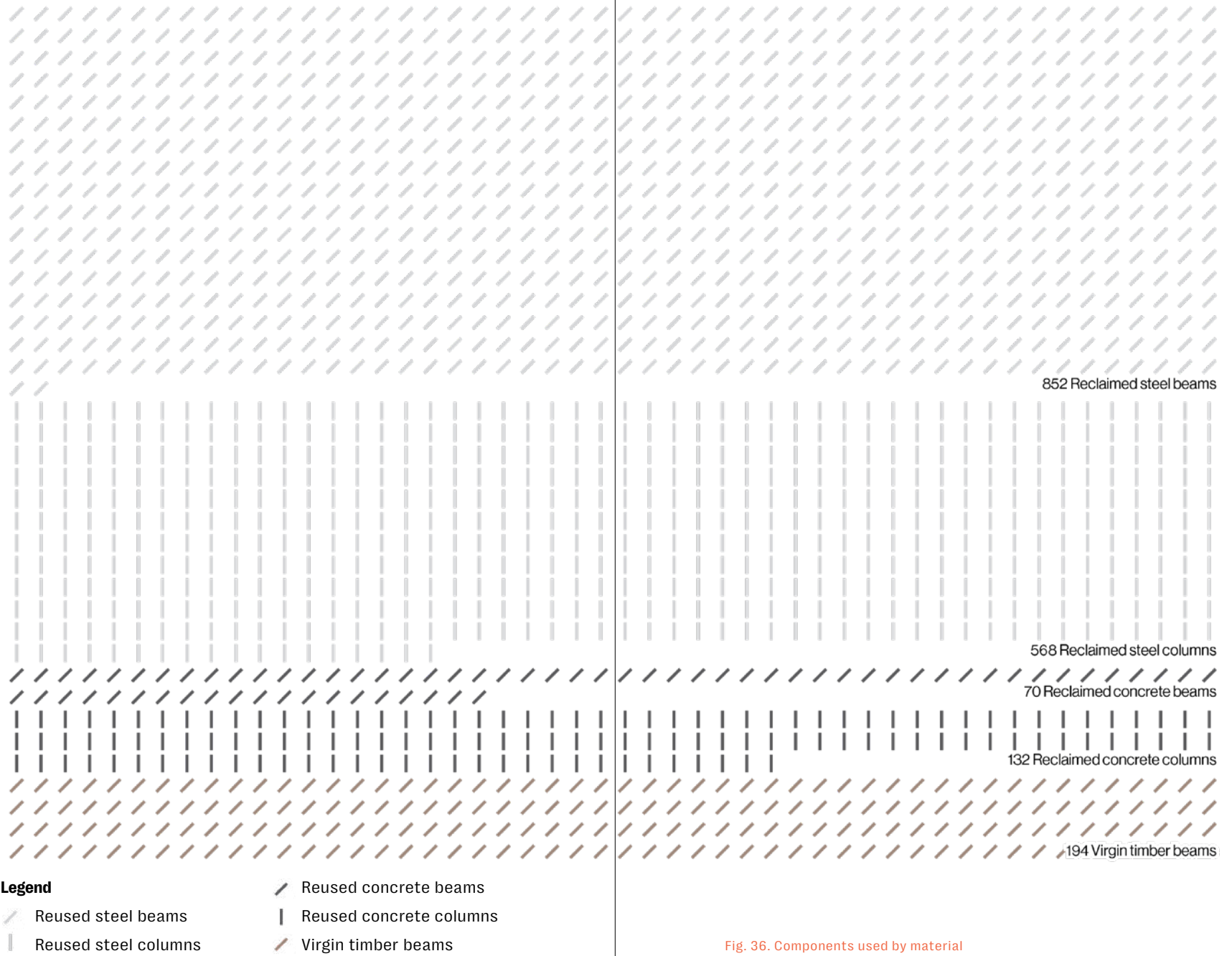
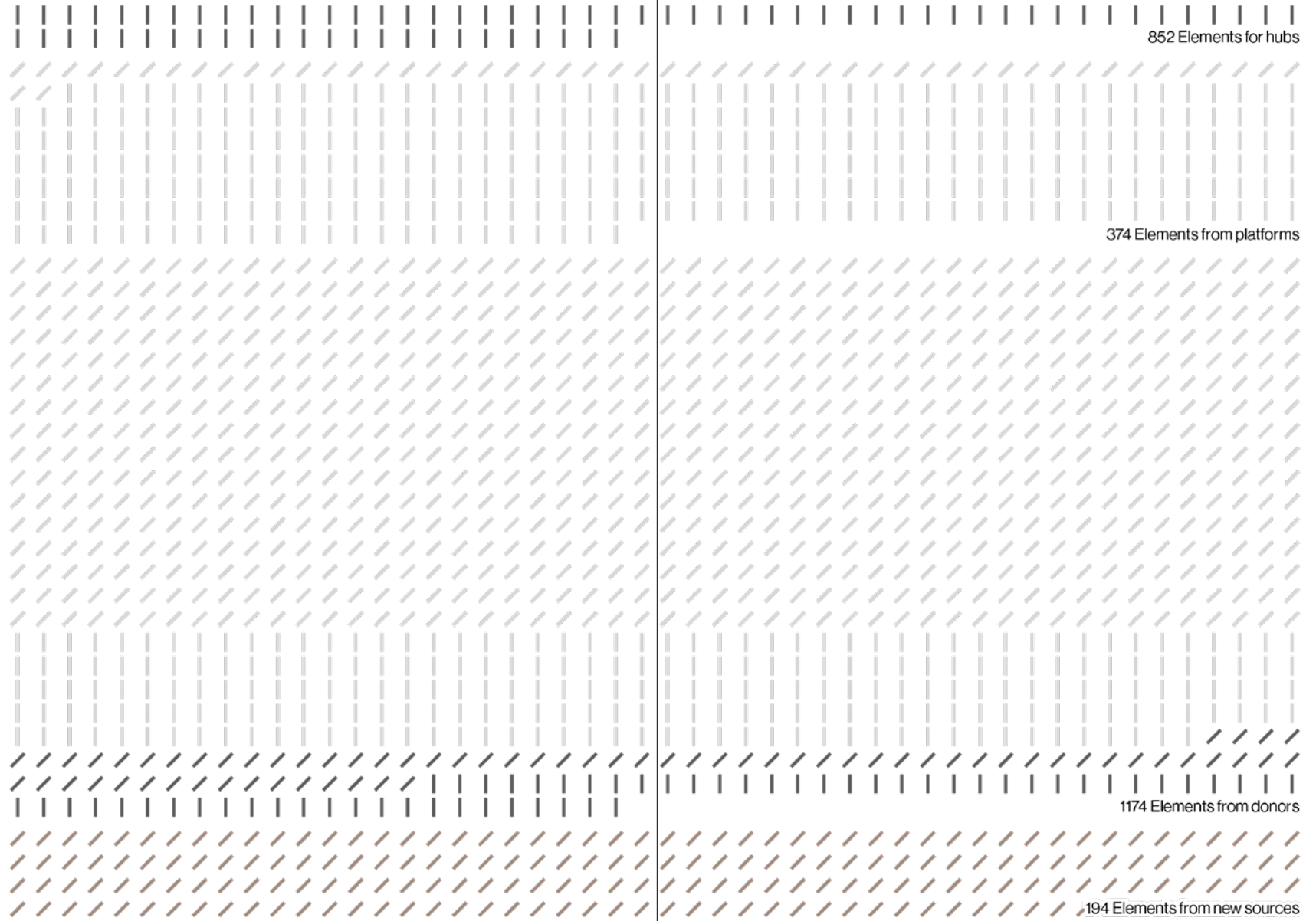


Fig. 36. Components used by material



Legend

- ▮ Hub Urban Miner
 - ▮ Platforms
- ▮ Donors
 - ▮ Timber source

Fig. 37. Components used by source

Situating knowledge – In conversation with Raouf Jarmo from RE:BORN Real Estate about De Satelliet

De Satelliet, the round tower of De Nederlandsche Bank in Amsterdam, was not demolished but carefully unbuilt. RE:BORN acquired the building not as real estate, but as a catalogue of components. Every floor slab, façade panel, and steel beam was dismantled and transported by electric boat to a storage hub in Amsterdam-Noord, where the material stock now waits for its second life.

Unlike the Tijdelijke Rechtbank, where components were fabricated for reuse within a closed system, De Satelliet demonstrates what it means to inherit an existing structure and hold it intact for future projects. This path is riskier: parts must be stored for years before a viable project emerges, tying up capital and space. Yet the principle is the same. If dismantling is done with precision, structures become future assets rather than demolition waste.

The project also exposes the question of timing. Material supply is irregular, dictated by demolition schedules, while new projects run on fixed permits and finance. Storage becomes the bridge. It is both a cost and an investment, turning reclaimed material into a strategic reserve.



Fig. 38. De Satelliet, purchased to be demolished. ©RE:BORN

The risk is that the longer stock remains asleep, the weaker the business case becomes. The opportunity is that certain components may appreciate in value as scarcity grows.

Ownership across the whole chain gives RE:BORN unusual control. The company manages sourcing, dismantling, storage, and eventual relocation, as there are the owner of all the components, which aligns incentives but concentrates exposure. To succeed, they must anticipate which materials will be in demand and maintain the logistical and administrative systems to keep them viable.

For Rebuilt Buildings, it shows that reuse is as much about custody as it is about design. Materials need holders who can bridge the gap between supply and demand, even when the interval lasts years. Then, policy could help distribute this responsibility: material hubs or public storage facilities would spread the risk that private actors now carry alone. The DNB case shows that storage, when strategically managed, is not dead weight but civic infrastructure.

Name	De Satelliet
Location	1st life: Amsterdam Storage : Amsterdam Noord 2nd life: The Hague
Years	1st life: 1970s–2020 Storage: 2021-2026 2nd life: 2026-...
Program	1st life: Offices 2nd life: Mixed-use
Size	8,000 m ²
Reuse intent	Acquire a building structure to deconstruct and rebuild
Reuse strategy	Careful dismantling, cataloguing, electricboat transport to hub, long-term storage with residual value in focus

2.3 The Flows, The Wait, and The Bureaucracy

Unlike conventional construction, where materials are following well established supply chains, Rebuilt Buildings navigates a fragmented, evolving inventory. Harvesting materials from one building and redistributing them across the built environment requires a new kind of supply chain infrastructure, ensuring that reusable components move efficiently across the territory. It requires connecting the now two separate worlds of construction and demolition.

The complexity of this operation means that reuse is not just a question of technical feasibility, but of coordination. Where do deconstructed materials come from, and where do they need to go? How do they get there? Who stores them in the meantime? And what are the chains of norms and certification to be successively followed?

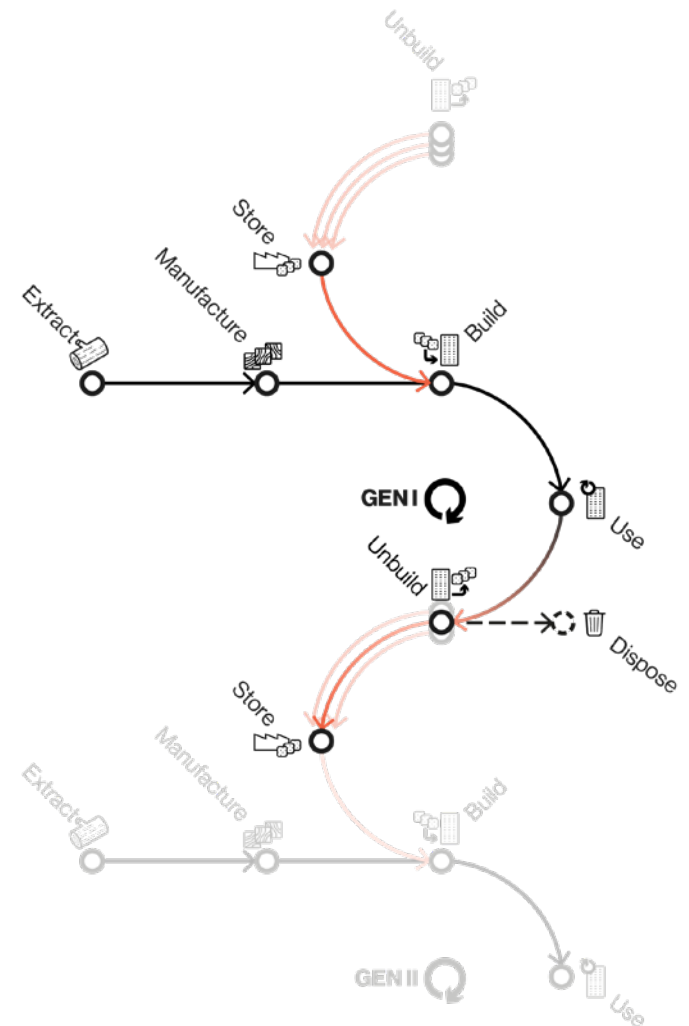
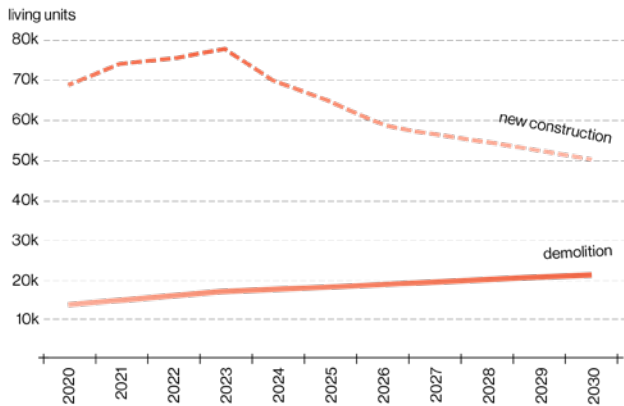


Fig. 39. The successive cycles of Rebuilding Buildings



➤ The Flows of Materials

The reuse of building components is about connecting what is being deconstructed, to what is being constructed. It is about connecting the two lines in the graph below. That simple connection embodies everything Rebuilt Buildings is about. Not as simple as connecting two lines of numbers in an excel sheet.

One of the challenges, which is also absent from this graph, is the where these flows occur. Where new homes are being built is not always right next to what is being deconstructed. By extension, materials will not always be needed in the same place where they become available. That can be said over the national, regional and city scales.

The next challenge is then: logistics. Unlike standardized supply chains, where materials travel predictable routes in bulk, reused materials move in smaller, irregular batches, often dictated by the pace of deconstruction. The choice of transport is then a crucial point in terms of cost and environmental impact.

When planning the transportation of harvested materials, we first consider their dimensions, since size determines the type of transport that can be used. Next, we look at the source location — not only the distance, but also factors such as emission zones that may affect the route or mode of transport. Finally, we take into account timing: both the urgency of dismantling and the schedule of the new project. If the materials already have a market but still require processing, speed becomes decisive, in which case road transport is often preferred despite higher costs.

Logistically, we first look at the dimensions of the material to be harvested, then where it is located, in connection with emission zones, but also transport distances, and finally at the planning.

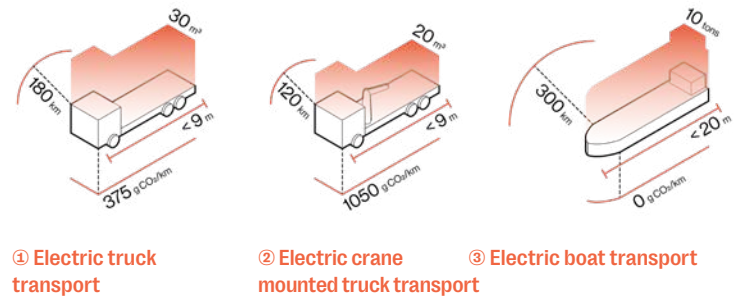


Fig. 40. Considerations of different transportation modes

Unintended consequences of circular construction come from the fundamental shift in logistics. Research on construction flows in the Metropolitan Region of Amsterdam shows that, while circular material reuse can reduce carbon emissions overall, it may also create local side effects: increased traffic movements, with resulting noise, wear on infrastructure, and localized air pollution.

For Rebuilt Buildings, this presents a strategic dilemma. The logistics of reclaimed materials demand a fine balance between efficiency, cost, and environmental impact. A steel beam salvaged from a demolition site in Amsterdam may need to be stored, reprocessed, and transported multiple times before being reinstalled into a new structure. Integrating circular materials into new buildings is not just a technical challenge but a logistical one—one that necessitates adaptive strategies in routing, hub placement, and transport mode selection to minimize negative externalities while maximizing reuse potential.

The step away from a material economy is a step towards a logistical economy. Less hungry in matter, but more in energy and labor. Less based on global transportation routes, but more on nascent micro-loops. Less impacting remote places, but more in the everyday local environments, in their air quality, its noise pollution, its transit.

➤ Where do the materials wait?

The logistical challenge for Rebuilt Building to be a scalable process, economically and spatially, is to aim for a near real-time connection between building donor and recipient—this is why Rebuilt Building is based on parametric design. But not all reclaimed materials are able to go directly from donor to recipient buildings. Often, there is a gap—sometimes weeks, sometimes months, but right now, often years—between deconstruction and reuse, for curing, certifying, or even to find a new owner. In the meantime, where do materials wait? Who holds them? And what is the cost?

Material storage facilities—or what is called circular material hubs—are emerging as critical intermediaries in circular construction. Material storage as a new type of critical collective infrastructure. These facilities hold deconstructed components until a project can use them.

Companies like Urban Miner, as one of the team-members of Rebuilt Building, specialize in salvaging, certifying, and selling reused components. They act as independent material banks, an intermediary offering material to multiple buyers. In that sense, they would buy from the market material to be reused in some of the projects of their consortium or for other buyers.

As part of the chains of decision making or breaking a Rebuilt Building is then linked to spatio-economic risks. Storage space needs to be financed to store material potentially in large quantities at once. This is why considering Rebuilding Buildings at scale pressure on reducing the time demand for storage to the minimum. The location of these storage spaces matters. The closer to the center the more expensive the storage space is, while the closer the transportation can become. That is the economic balance to be found.

As part of the risk assessment conducted by Urban Miner includes what is being bought and stored. A storage area occupied by a concrete column is not bearing the same risks and opportunities as for a steel beam. Some elements are in high supply or demand today, while some have the promise to be in high demand or supply tomorrow. That is the calculation to ensure the space a supplier owns is not filled with elements that are not particularly looked for in new buildings.

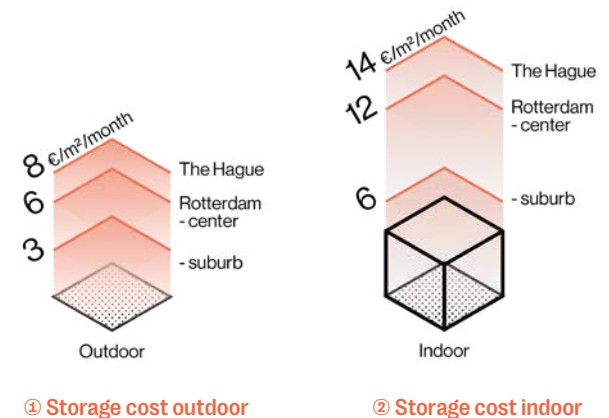


Fig. 41. Cost of different storage possibilities – Appendix 1

Reused components	Concrete	Steel	Wood
	Column Beam Slab	Column Beam Slab	Column Beam Slab
Average storage time (in days)	270/180/270	120/120/120	90/120/160
Demand today?	↓/↓/↓	↓/→/↓	↓/→/↓
Demand future?	↓/→/→	→/↑/↓	→/↑/↓
Supply today?	↓/→/↓	→/→/↓	→/→/↑
Supply future?	→/↑/↓	↑/↑/→	↑/↑/↑

Fig. 42. Considerations of different transportation modes

For Rebuilding Buildings at scale, the new frontier of scarcity is space of storage. To maintain materials in circularity, one must ensure the continuity of use of components.

➤ The timeline of bureaucracy

Creating a building from reused parts is as much a logistical challenge as a regulatory one. From demolition to reassembly, the project must trace each element through a transparent, verifiable chain of custody.

In Amsterdam, any major demolition requires prior notice—known as a “slopmelding”—at least four weeks in advance. This can be extended if the building is protected or if it forms part of a larger permit. During this waiting time, materials can already be catalogued and buyers lined up, though the dismantling process itself takes longer than standard demolition because elements must be carefully removed intact.

Once harvested, components are transported and stored, ideally under a “voortgezet gebruik” status to avoid classification as waste. But this phase carries legal nuance: under Dutch waste law, materials kept in storage for more than three years risk being considered discarded. Testing and certification are often needed to verify whether a component—say, a 30-year-old concrete beam—still meets today’s performance standards. These tests take time and money, and are typically based on criteria for new materials, even when applied to reused ones.

Hubs like Urban Miner acts as a central hub in this process, taking over legal responsibility for the quality of harvested materials and the financial risks. This means accepting the risk that some items may later fail inspection or fall short of standards. To mitigate this, components are assessed by independent labs that provide supporting documentation. But even then, many reused elements arrive without certificates, or with paperwork that is outdated or incomplete.

When it comes time to apply for a building permit using these elements in a new construction, extra scrutiny is inevitable. Municipalities often ask for structural reports proving the reliability of second-hand components. Each cycle of back-and-forth—providing additional test results or engineering justifications—can extend the timeline. Where conventional applications might be approved in two to three months, circular ones often take three to four.

Despite these hurdles, the process is increasingly well understood. As more projects thread reused materials through these bureaucratic layers, the chain of custody becomes clearer—and the case for reuse, stronger.

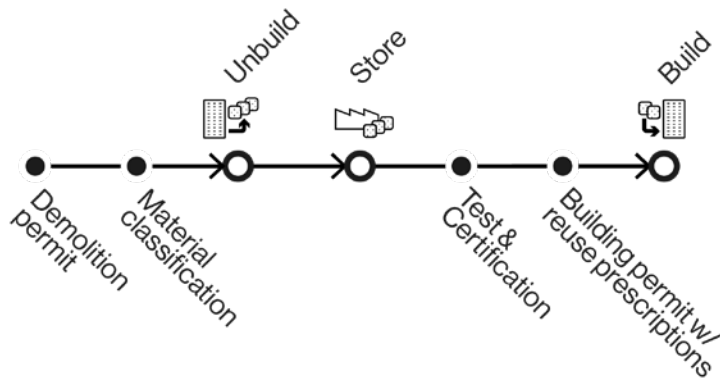


Fig. 43. The bureaucratic path of reused components

➤ In practice

The Rebuilt Building investigated in this report follows a live sourcing strategy based on real-time availability of structural components—drawn from online platforms, local hubs, and donor buildings. Because the final structure emerges from actual stock rather than fixed plans, logistics must follow this moving target.

Transport operations are calibrated to the capacity of an electric truck, able to cover round trips of roughly 180 km on a single charge. Based on the total volume of reclaimed components—around 2,000 m² of usable footprint—approximately 50 round trips are expected to deliver elements to Urban Miner’s storage facility near Rotterdam. Once consolidated, the same truck will complete another 50 trips of around 150 km each to move the materials from the hub to the construction site in Amsterdam.

Altogether, transport represents a total cost of €96,100, generating approximately 6.2 t CO₂. Even though this remains modest compared to the overall construction budget, it is an important line to monitor both for feasibility and for emissions. The data show that logistics now accounts for a visible portion of the reuse carbon footprint—roughly two-thirds of the residual impact of a reclaimed steel element—making routing and transport mode central design considerations.

The storage of materials has been dimensioned according to the nature and quantity of the reclaimed elements. Steel beams and columns—around 1,700 m² of footprint—are stored outdoors under cover, as they can tolerate temperature swings and ambient

humidity without performance loss. Concrete elements, representing about 300 m², are stored indoors to prevent damage from moisture cycles and freezing.

Storage is expected to last twelve months, allowing time for collection, inspection, testing, and certification. The layout allocates 850 m² of outdoor yard space and 150 m² of indoor warehouse, together costing €82,800 for the year—€6 /m² month outdoors and €12 /m² month indoors. These costs are higher than initial estimates but remain within feasible limits given the project’s experimental scope.

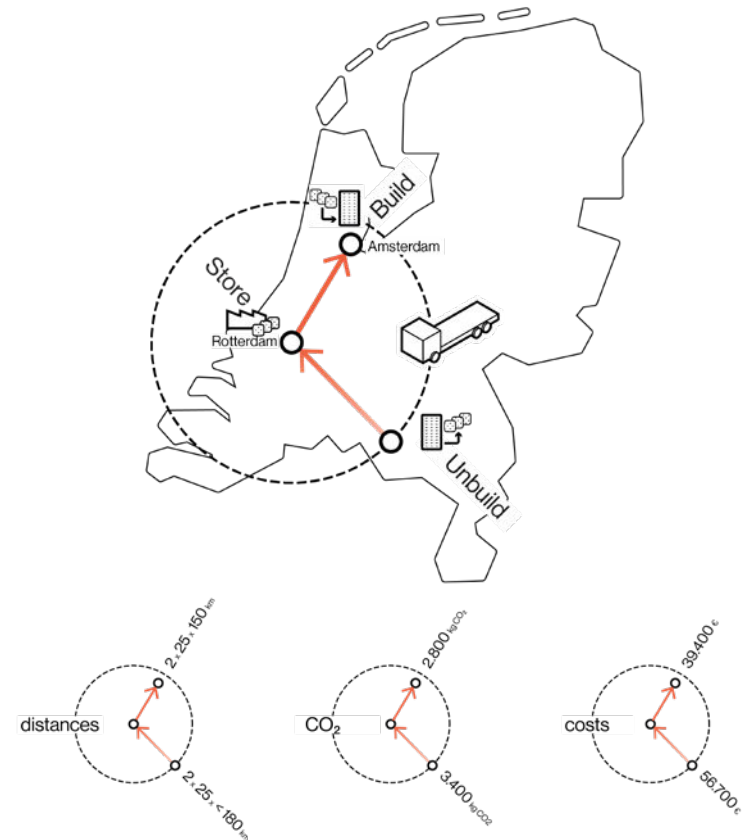
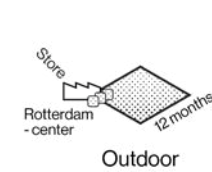


Fig. 44. Transporting the reused components of the Rebuilt Building – Appendix 2

Compared with early-stage projections, logistics now represents a non-negligible budget line, approaching €180,000 combined for storage and transport. Yet, even at this level, it stays far below the cost of new structural production, while enabling the deep reduction in embodied carbon achieved through reuse. Once the materials themselves are reclaimed, the environmental and financial performance of reuse depend primarily on logistics—how components are moved, stored, and matched to new projects.

Reducing distances, consolidating loads, and planning material flows across multiple sites will therefore be the next arena of optimization. In future iterations of the Rebuilt Building, integrating shared hubs or regionally coordinated storage could halve both costs and emissions, turning logistics from a liability into a key lever of circular performance.

Outdoor duration surface cost



Indoor duration surface cost

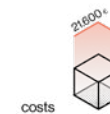
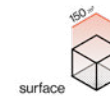
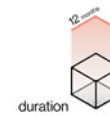
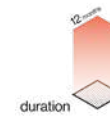
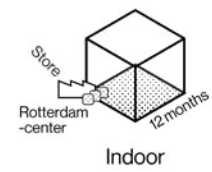
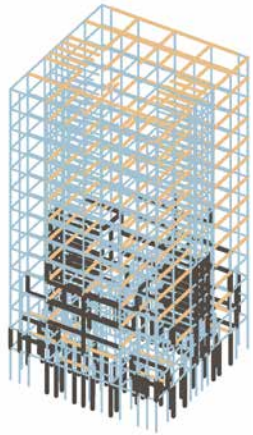
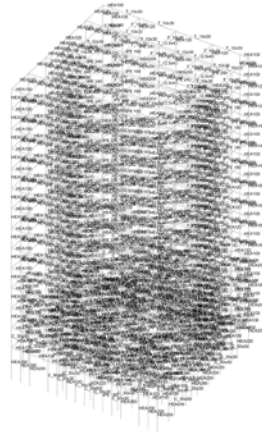


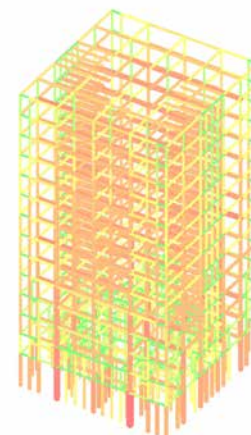
Fig. 45. Storing the reused components of the Rebuilt Building – Appendix 3



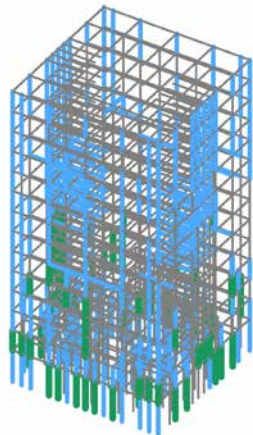
Materiality



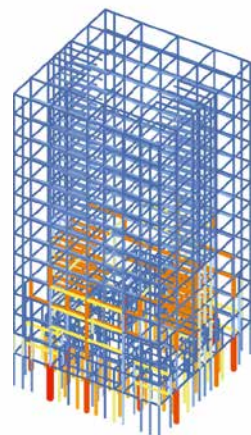
Elements ID



Embodied CO₂



Source



Weight

"We have stored parts for 4 years. This allowed us to build cheaper and circularly."

Raouf Jarmo, RE:BORN

Fig. 46. Datascape of the Rebuilt Building's structure

The Rebuilt Building

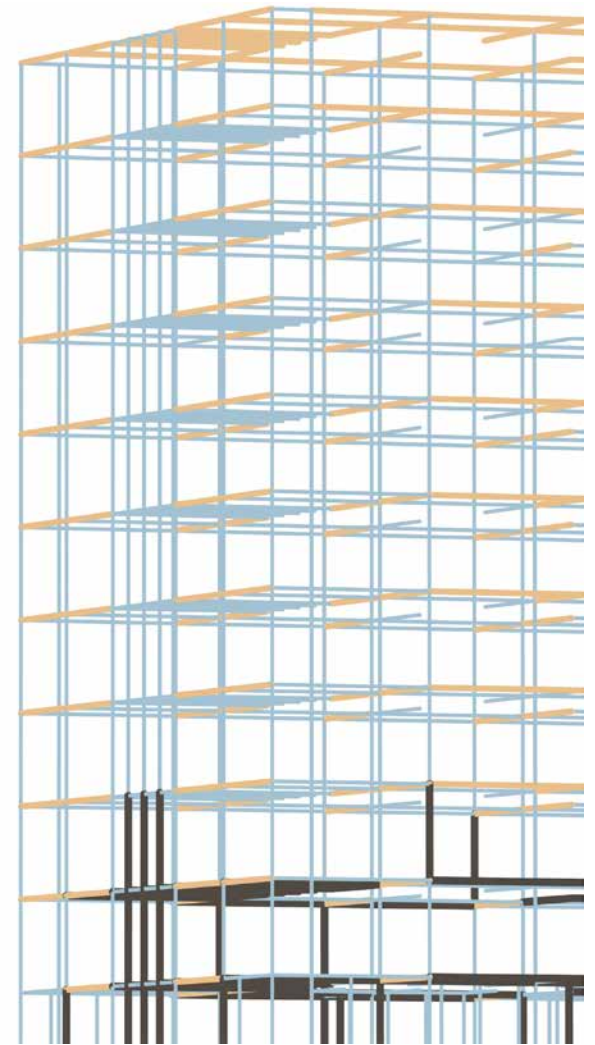


Fig. 47. Materiality

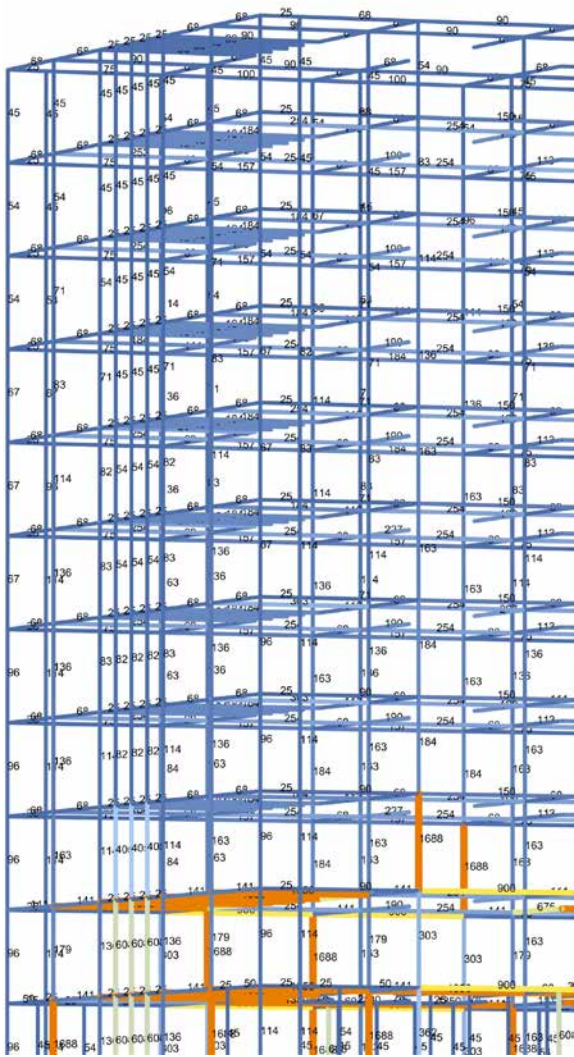


Fig. 50. Weight

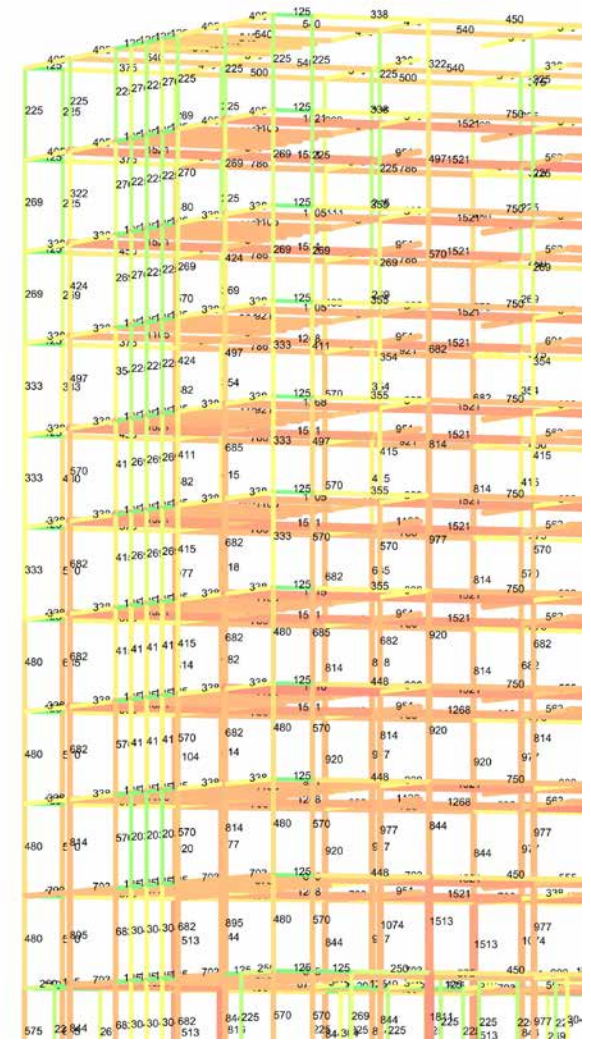


Fig. 51. Embodied CO₂

Situating knowledge – In conversation with Jan Jongert from Superuse Studios about Boschgaard

Boschgaard in 's-Hertogenbosch turns a former community centre into a cooperative housing project with nineteen homes and shared spaces. Superuse approached the project not with a fixed palette of new products, but by harvesting what the region already offered. Doors, beams, façades, and finishes were sourced through urban mining networks, held in temporary storage, and re-designed into the new cooperative structure. Reported reuse rates of more than eighty percent confirm the scale of what is possible when design begins with existing stock.

This differs again from the other case studies. The Tijdelijke Rechtbank proved the value of designing components for future reuse, the DNB tower showed the risks and opportunities of banking an entire building for later. Boschgaard illustrates the third path: building directly from an irregular and incomplete stream of reclaimed components. Here, the emphasis shifts to tolerance and governance. The housing cooperative, the contractor, and the design team worked together to accept imperfections, adapt grids, and adjust details. Variation was then considered as a design parameters to play with and not to eliminate.

The project also reveals the hidden economics of circularity. Storage space and scouting time carried real costs, but were offset by sufficiency and substitution:



Fig. 52. Boschgaard, designed with reused components.
© Superuse Studios

accepting what existed rather than insisting on perfect matches, and complementing gaps with biobased materials where reuse was impossible. Social organisation mattered just as much. A cooperative client and an aligned contractor created room for iterative decisions that would have been filtered out by conventional tendering.

For Rebuilt Buildings, Boschgaard frames reuse as a design capacity as much as a technical one: tolerance in grids, details, and planning makes irregular stock viable. Additionally, governance is part of the material chain. Without collective ownership and trust among partners, high reuse would have collapsed under the weight of friction.



Fig. 53. Boschgaard, designed with reused components.
© Superuse Studios

Name	Boschgaard Housing Cooperative
Location	's-Hertogenbosch (Den Bosch)
Years	2024
Program	Cooperative housing
Size	-m ²
Reuse intent	Urban mining of regional stock for cooperative housing
Reuse strategy	~84% reused materials, ~70% CO ₂ reduction; irregular reclaimed elements integrated through fine grid design, storage, and biobased complements

2.4 Values: economics and beyond

➤ Define Costs

Economics is often the first and final argument against reuse. Every deviation from standard practice—materiality, logistics, certification—adds friction to the business case of a building, particularly once construction materials are reclaimed. These frictions are quickly translated into priced-in risks and uncertainties. Yet the economy of building is less an exact science than a designed system operating within its own culture.

The task, then, is to make the economic case for Rebuilding Buildings. To do this, we need to examine where costs form, how value is accounted for, and what can be learned from realized projects to reveal both the constraints and the leverage points of reuse within current frameworks.

The current definition of value in construction rewards predictability, newness, and repetition. Reuse, by contrast, follows a different economic logic—one grounded in long-term stewardship rather than short-term return. Making the economic case for Rebuilding Buildings therefore means asking how costs are formed, where value is lost or hidden, and which parts of the system could be redesigned to make circular practice viable.

Economic viability studies in construction are built on the assumption of predictability. A traditional business case rests on the premise that material supply, pricing, and timelines can be forecast with reasonable certainty. Costs are derived from benchmarks and standardized rates. This model allows developers to treat buildings as stable financial products—calculable, comparable, and predictable at every step of the development process.

To make the case for the Rebuilt Building, we combine high- and low-resolution information, merging generic metrics such as cost per square metre with specific prices of structural components—columns, beams, slabs. For the Rebuilt Building, values integrate new factors such as testing, storage, and logistics that are usually not

yet known in the early stages of building development. The economics of reuse depend as much on process design as on the price of materials. This introduces uncertainty but also a broader field of design agency.

Our comparisons are informed by the K.118 building in Winterthur, Switzerland, which offers rare insight into the detailed cost composition of reused materials. From this foundation, we build a broader economic analysis comparing conventional concrete, biobased timber, and hybrid reuse structures, before testing how external shifts—policy, taxation, or material volatility—could alter the balance in the near future.

Rather than treating economics as an external constraint, the aim is to understand it as part of the design field itself: a structure of relations, incentives, and values that can be reconfigured through practice. The question is not only whether Rebuilding Buildings can compete within the existing market, but how the market itself might be—or already is—redesigned so that reuse becomes the ordinary condition of building.

Economics is less an exact science than a designed system shaped by what we choose to value and predict.

➤ Learning from others

In *Reuse in Construction: A Compendium of Circular Architecture*, the authors examine how circular construction can conserve scarce resources and cut greenhouse-gas emissions through the concrete example of erecting an actual building.

The book is both handbook and deep-dive. Drawing on the K.118 project in Winterthur, Switzerland—the country’s largest building constructed mainly from reclaimed components—it unpacks many of the challenges architect and engineer meet, from design and energy to economics, process management, and law. Since 2018, K.118 has been tracked by an interdisciplinary research team. Although K.118 stands in Switzerland and addresses more than just a building’s structure, its lessons map directly onto our own Rebuilt Building initiative above all for expectation-setting in the feasibility phase.

Material costs for reuse can match, or slightly exceed, those for new products. For K.118’s steel frame, reclaimed columns and beams proved to be roughly 7 % more expensive than new equivalents. Under the

right conditions, however, reuse could compete. Especially once non-material benefits, such as residual value, carbon savings, risks management, or branding are factored in.

A closer look at cost distribution across the life-cycle of a reused steel element highlights two leverage points. Combined, transport and storage account for about 11 % of a reclaimed component's cost. Optimizing these two stages is therefore pivotal to a robust business case under current legal and tax conditions.

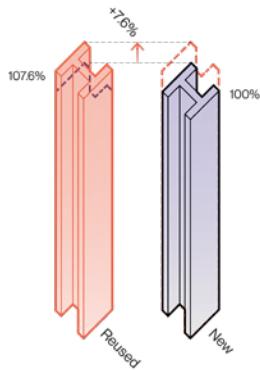


Fig. 54. Compared cost of reusing a steel column of K.118

To understand under which conditions reclaimed components could be economically optimized, it helps to see where along the process these costs accumulate, which include:

Search – Locate candidates; inspect condition; log dimensions and provenance.

Purchase – Pay seller or donor; cover brokerage/platform fees.

Unbuild – Dismantle with care, safeguarding structural integrity.

Transport – Move components to and from interim storage.

Store – Protect, inventory, and manage stock.

Prepare – Clean, upgrade, adapt (e.g., remove residual concrete, add end plates, apply fire protection).

(Re)Build – Integrate into the new structure, allowing for fixings, tolerances, and on-site adjustments.

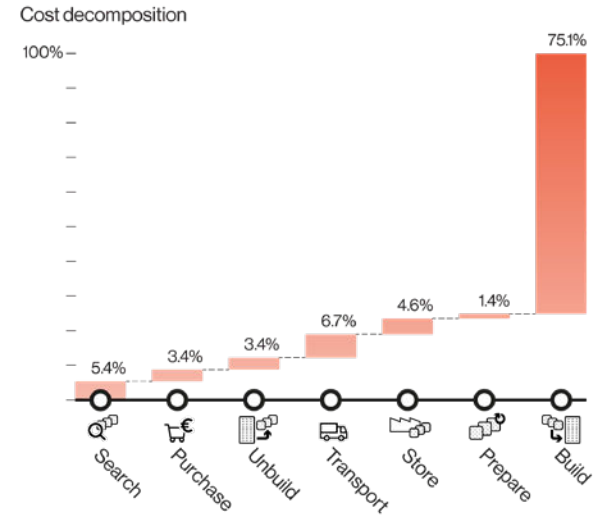


Fig. 55. Cost decomposition of reusing a steel column of K.118

At first glance, the cost distribution across the life-cycle of a reused steel element shows that the majority—around 75.1%—comes from labor in constructing the new building. This mirrors traditional construction in the Netherlands, where labor consistently outweighs material costs.

Looking more closely, two leverage points emerge for the Rebuilt Building. First, transport and storage together account for about 11% of a reclaimed component's cost; optimizing these stages is therefore pivotal to building a robust business case under current legal and tax conditions. Second, the Rebuilt Building approach significantly reduces costs for material sourcing by drawing directly from online platforms and material hub databases, avoiding much of the expense of traditional material research. Taken together, these insights hint to how the business case for the Rebuilt Building can be approached.

K.118 teaches us that when we tame the twin hurdles of transport and storage, reclaimed materials rival the cost of new ones, showing that circular architecture can be both achievable and desirable.

➤ Relative economics

To test whether reuse can become competitive under ordinary project conditions, we compare three structural logics within a controlled setup. The aim is not to fix absolute prices, but to see how changes in structure reshape the economics of a building.

In order to properly assess the feasibility and potential of a circular business case, three construction scenarios were compared, mirroring the options a housing project would realistically consider today:

① **Traditional construction** – concrete structure with conventional installations and linear material use

② **Timber hybrid** – primarily CLT timber construction combined with concrete floors and cores

③ **Reuse hybrid, aka Rebuilt Building** – a timber framework complemented by reclaimed components such as stairs, façades, steel members, and installations, aka Rebuilt Building

To explore these scenarios, we first examine the differences in construction costs—the minus side of the accounting sheet—and then look at the different value streams—the plus side of the accounting sheet.

To make the comparison consistent, the building brief is kept identical across all three scenarios. We ask a simple question: what if the same project were built in concrete, in timber, or from reused components? The program, massing, location, and unit mix correspond to a 9,000 m² multi-unit housing project of fourteen floors and approximately fifty metres in height.

The comparison isolates what changes when circular strategies are applied by holding constant a series of baseline parameters. These variables together describe where circularity introduces both added cost and potential long-term value.

Taken together, the comparison lets us separate the market’s baseline, the biobased alternative, and the reuse-first approach of the Rebuilt Building, showing not only what each costs to build, but how each treats value across time.

➤ Cost of building

Let’s now look at the direct costs of constructing the same building through three different structural pathways. The goal is to identify where cost differences actually occur and how they relate to circular strategies.

Because the focus lies on the structural system, other building layers are treated as constant. All of this lead to the combined layers of the Skin, the Space Plan, and the Services to be relatively similar besides small variations. Within the structure, we assume comparable approaches to floors, cores, and foundations as these were out of the current focus of Rebuilt Building, but noting that foundations vary as the building weight varies.

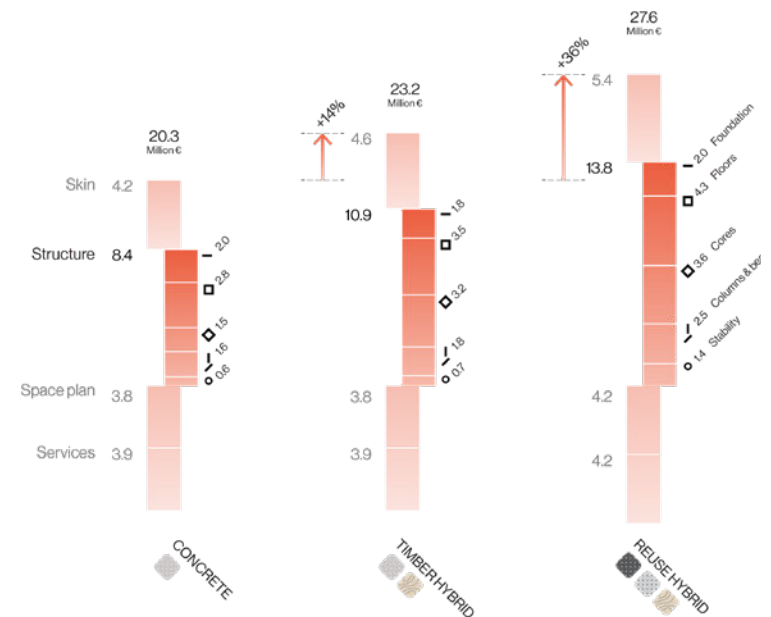


Fig. 56. Comparison of building costs for different scenarios – Appendix 4

First, it's important to note that these figures should be read as indicative and relative, not precise and absolute. They are designed to reveal proportions rather than precise numbers. What matters is not the exact cost but the relationship between scenarios. All estimates combine standard benchmarks with project-specific adjustments for sourcing, testing, and logistics, making them representative of current market conditions rather than prescriptive—the new mix of high- and low-degrees of abstraction emerging from a new circular material reality.

Traditional concrete construction remains the most economical option, averaging €2,278 per m² BVO (total €20.3 million), well within the prevailing market bandwidth of €2,000–2,300 per m² and reflecting a mature, highly standardized system in which cost, risk, and delivery are well understood. Timber-hybrid construction follows at €2,603 per m² BVO (€23.2 million), roughly 14% higher than concrete and comfortably within the timber market range of €2,400–2,900 per m², signaling its growing normalization as a mainstream structural solution. The reuse-hybrid reaches €3,097 per m² BVO (€27.6 million), about 36% above the concrete baseline yet positioned at the lower edge of the reuse market bandwidth (€3,000–4,000 per m²). This premium is not primarily driven by material cost, but by contingencies priced in to manage uncertainty—variable availability, verification, non-standard detailing, longer coordination cycles, and unfamiliar approval processes—indicating that what is being paid for is not reuse itself, but the absence of an established system around it.

Seen through this lens, the comparison reveals a deeper shift in how value is produced. Conventional construction concentrates value in standardized products purchased at predictable prices. The Rebuilt Building, by contrast, relocates value to systems: logistics, certification, coordination, data, and timing. These appear today as additional costs because they sit outside established procurement routines. Yet they are precisely the elements that can improve most rapidly through repetition, shared infrastructure, and institutional learning.

This is not unprecedented. Timber construction followed a similar trajectory. A decade ago, it was widely perceived as risky and expensive, burdened by insurance premiums, limited contractor experience, and regulatory uncertainty. Over time, standards, certification pathways, and accumulated practice reduced that uncertainty, and with it the cost of risk. The same dynamic applies to reuse. The

current premium should therefore be understood not as structural, but transitional—a snapshot of a market still learning how to operate circularly.

The economic question raised by the Rebuilt Building is thus not whether reuse is inherently too expensive, but why uncertainty is priced so aggressively. As verification protocols stabilize, component databases mature, and logistics are planned across multiple projects rather than treated as one-off operations, much of this premium can be expected to dissolve. What remains is not a penalty for circularity, but a reallocation of value toward durability, recoverability, and long-term material stewardship.

What separates the three business cases is not only cost but culture, the way value, risk, and responsibility are distributed across time. Understanding this would help to pave the way for more Rebuilt Buildings.

➤ Closing the business cases

If the previous section examined the minus side of the balance sheet, this one turns to the plus: how different construction systems generate and retain value over time. The comparison includes both direct financial indicators and the emerging forms of worth that circular practice introduces.

Development and planning fees are assumed to follow conventional rates across all scenarios. Financing conditions, such as interest and yield expectations, remain consistent as well. These constants keep the comparison grounded in a fair baseline. What varies are the structural logics and their capacity to hold residual value once the building's first life ends.

In the traditional concrete model, total project value reaches €43.5 million, with unit sales of €46.5 million. Value peaks at completion and then depreciates linearly. Structural components are cast monolithically, and once demolished, almost nothing is recovered. Residual value is not accounted for, while maintenance and replacement costs accumulate over the building's lifetime.

The timber hybrid improves overall performance, reaching a total value of €47.9 million and unit sales of €48.8 million, around 5–10% higher than concrete. While timber components are prefabricated and potentially demountable, this capacity is rarely translated into

financial models. As a result, timber buildings are still largely treated as depreciating assets, despite their materially different logic.

The Rebuilt Building introduces a different value structure. With a total project value of €54.7 million and unit sales of €55.2 million—19–26% higher than concrete—it is the only scenario in which residual value is explicitly recognized. An estimated €4.1 million in material value is retained beyond the building’s first life. Here, the higher upfront construction cost functions not as a loss but as a deferred investment. Materials are inventoried, traceable, and capable of re-entering circulation rather than being written off at demolition.

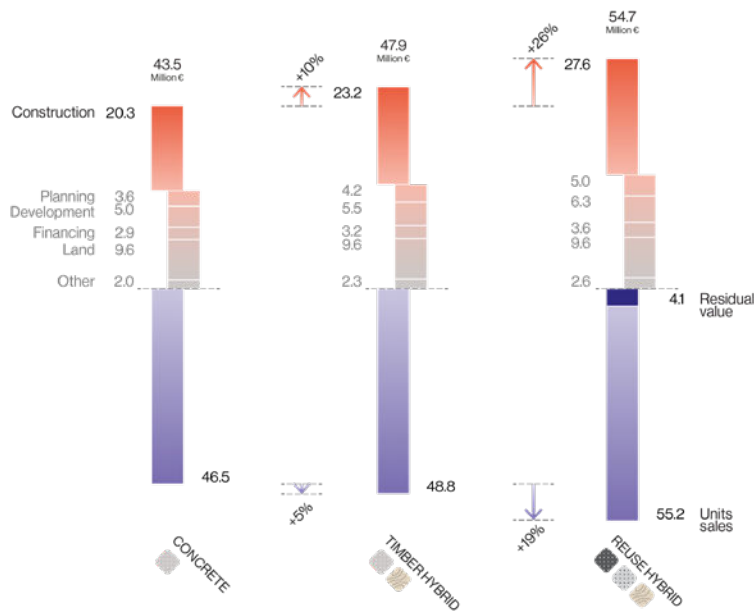


Fig. 57. Value composition of the business case

Seen this way, the reuse hybrid does not simply cost more to build; it behaves differently as an asset. Its performance depends less on the intrinsic price of materials than on the organization that manages certification, documentation, and timing. Value shifts from extraction and consumption toward stewardship and recovery.

Within today’s market conditions, this redistribution of value also clarifies where reuse is most immediately viable. Projects under high land-value pressure and developments positioned toward the upper end of the residential market are better able to absorb higher upfront costs while capturing the added value of circularity. In these contexts, reuse can operate as both an environmental strategy and a differentiating quality that supports a premium. This is the current reality of the system: circular construction does not yet perform evenly across all market segments.

Acknowledging this does not weaken the case for reuse, but shows the current reality. These early applications function as testing grounds where organizational capacity, valuation models, and market confidence can mature. Other near future scenarios can be explored to show how changes in regulation, pricing, and financing could extend this logic beyond high-value niches—turning what is currently a premium strategy into a mainstream condition of building.

The way value is currently defined in construction rewards predictability, newness, and repetition, while reuse follows a different economic logic based on long term stewardship.

Define values

While reuse may appear slightly more expensive on paper, its impact on carbon and resource use makes it the most effective path to reducing the footprint of building. The environmental value of Rebuilt Buildings lies in extending the lifespan of materials that already exist. Each component kept in circulation prevents new emissions, avoids additional extraction, and delays waste. The cost-to-impact ratio is where Rebuilt Buildings find their true value.

As discussed earlier, understanding a building’s economics as part of the design field also means redefining what is priced in and what is treated as an externality. In traditional construction, material use and carbon emissions are parallel metrics—useful for securing permits or supporting branding claims—but rarely placed on the same level as the material and labor costs of a real-estate operation.

In the Rebuilt Building, the value of the approach becomes clearer once environmental impacts and material sobriety are priced in. These parameters are not merely socio-environmental ideals; they translate into sound economic strategy. Considering how sharply material prices shifted during the Covid period, using fewer materials can be calculated and priced as part of risk management. Similarly, environmental impacts can be understood as societal costs. As the EU taxonomy begins to take effect, it is not far-fetched to imagine that the carbon impact of construction will soon be priced in directly.

In today's context—where impact investing is a growing field and local authorities are increasingly internalizing the environmental consequences of building—it becomes essential to redefine what we mean by the value of a building.

As with the economic analysis, assessing environmental value requires navigating different degrees of abstraction. High-level metrics—like embodied carbon or MPG—offer comparability across projects but little sense of where those impacts occur. Project-specific data, by contrast, reveals the tangible mechanics of reuse, how materials are sourced or moved. We combine both perspectives—looking first at the specific conditions of a realized project and then at broader benchmarks—to understand how environmental value is created in practice.

Redefining value means extending accounting beyond money, including energy, matter, and emissions that buildings consume or avoid.

➤ Learning from others

As in the economic analysis, the K.118 project in Winterthur provides a first understanding of the environmental impact at the level of individual components. The building's full documentation of its reclaimed structure allows a precise accounting of greenhouse-gas emissions linked to each reused element.

Reusing a steel column or beam trims its embodied footprint by about 91%. A reclaimed member carries only nine percent of the carbon load borne by a newly rolled section. In other words, almost the entire climate burden of a steel component lies in its first production, not in its continued use.

A closer look at the life-cycle emissions of one reused steel element reveals where the remaining impact occurs. Around two-thirds—68%—of total emissions come from transport—moving the component between the donor site, the storage hub, and its new project. This makes geography and logistics as decisive as material efficiency. Locating storage hubs close to both deconstruction and reconstruction sites, consolidating shipments, and using renewable or electric transport can dramatically lower the footprint.

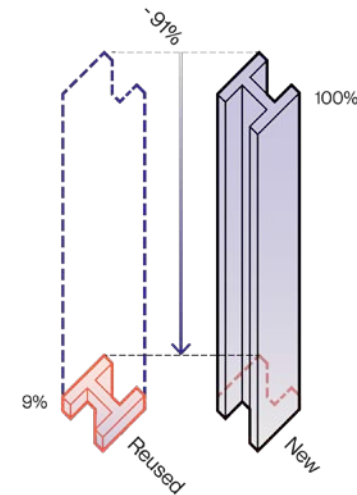


Fig. 58. Compared GHG emissions of reusing a steel column of K.118

For the Rebuilt Building, this finding reframes the design priorities. Once a component is reclaimed, its carbon performance depends less on what it is made of than on how it moves and is handled. Shorter routes, fuller loads, low-carbon transport, and careful dismantling and re-assembly reduce emissions far more effectively than minor material substitutions.

K.118 shows that circular architecture delivers its largest environmental gains not through new technologies but through smarter organisation. Carbon efficiency becomes a spatial and logistical question—one that links construction practice directly to the geography of reuse.

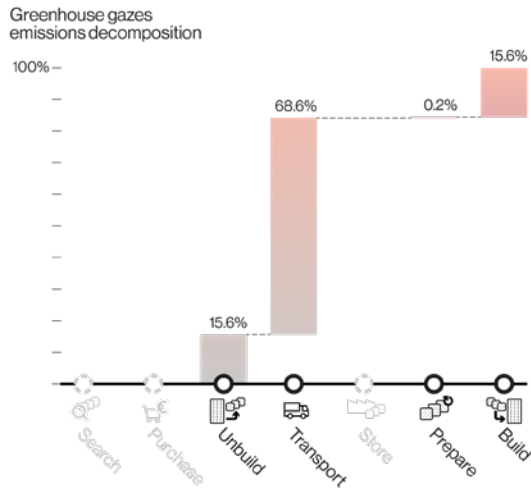


Fig. 59. GHG emissions decomposition of reusing a steel column of K.118

➤ Values of building

Let's now look at the environmental balance sheet of constructing the same building through the three different structural pathways. The goal is to identify where the largest differences occur and what they reveal about the environmental logic of circular construction.

The comparison applies to the same project parameters used for the economic cases. The three variants remain: a traditional concrete structure, a timber hybrid, and a reuse hybrid composed of reclaimed components. Here as well, all non-structural layers—skin, space plan, and services—are treated as constant, allowing the results to isolate the effect of the structural system itself.

Across the three systems, the conventional concrete structure performs worst in terms of embodied carbon. Its total footprint reaches 308 kg CO₂e per m² BVO. Switching to a timber hybrid reduces this impact to 261 kg CO₂e per m², a decrease of approximately 15%. The reuse hybrid performs best, lowering the footprint further to 233 kg CO₂e per m²

reduction of 24% compared to concrete. These reductions are driven primarily by changes in the structural layer, while other building layers remain broadly comparable.

What this comparison makes explicit is that structural choices dominate environmental performance. Even

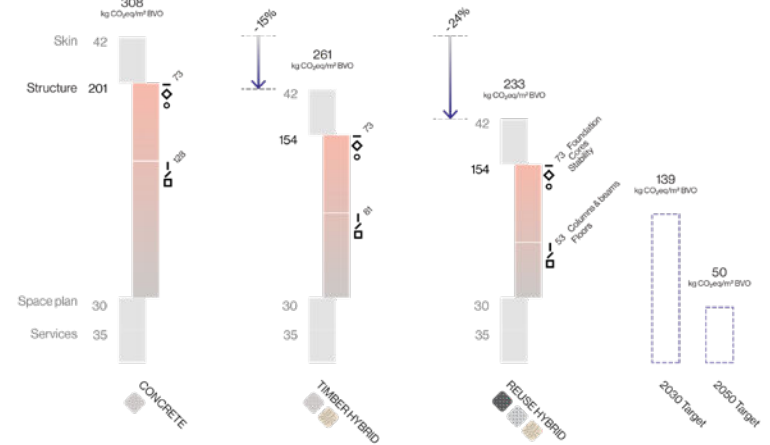


Fig. 60. Comparison of CO₂ emissions for different scenarios – Appendix 6

modest changes at the level of columns, beams, and floors translate into substantial differences at the scale of the whole building. The reuse hybrid demonstrates that keeping structural elements in circulation delivers climate benefits that cannot be matched by material substitution alone.

While the embodied impact of beams and columns is already drastically reduced, lessons from K.118 show that further gains depend less on material choice than on logistics. Transport currently accounts for more than two-thirds of the remaining emissions of reused steel. Optimising hub locations, shortening routes, and coordinating flows between demolition and construction sites could significantly reduce this share. The next design frontier therefore lies as much in spatial organisation as in structural engineering.

Expanding the scope of the Rebuilt Building to other parts of the structure would further amplify these gains. Slabs, cores, and foundations represent a large share of embodied carbon, yet they remain difficult to reclaim. The market currently offers few reusable solutions for these elements, making continued innovation in modular slabs, demountable cores, and hybrid foundations essential to push circular construction beyond its present limits.

Beyond the structure itself, similar opportunities emerge

in other building layers—façades, services, and finishes—where reuse could further reduce the overall footprint.

Even with its strong performance, the reuse hybrid still exceeds European benchmarks for 2030 and 2050, particularly for high-rise buildings where structural demand is high. Meeting those long-term targets will require extending circular strategies across all layers of the building, translating today's leading practice into tomorrow's common standard.

While reuse may appear more expensive under today's market conditions, this premium reflects what is not yet counted rather than what is inefficient. Once environmental impact, material scarcity, and long-term value retention are priced in, reuse becomes increasingly competitive. In that shift, the performance of a building is defined not only by the materials selected at construction, but by how long its structure remains in use and whether its components are allowed to circulate beyond a single lifetime.

➤ Scenario's and What's ifs

While we looked the economics and environmental logic of circular construction as they stand today, both are subject to forces that change quickly—policy, pricing, regulation, and perception. The following scenarios extend those logics into near-present conditions, asking what happens when the boundaries that shape construction begin to shift.

What if material prices become even more unpredictable?

Global disruptions over the last few years have made steel, concrete, and timber prices volatile. In linear systems, this volatility translates into risk. In circular systems, it can become leverage. Reused materials are less exposed to global market fluctuations, and their value can even rise in periods of scarcity. Instead of being at the mercy of extraction and transport chains, projects grounded in local material flows can stabilise costs and capture value from resilience itself.

What if we include residual value in the calculation as standard?

Conventional financing still treats buildings as assets that depreciate to zero at demolition. Circular models treat them as material banks that retain future value. When residual value is integrated into the financial model, total cost of ownership decreases and risk profiles improve, especially when material passports and certification guarantee traceability. A project that looks marginal in linear accounting can become attractive once its recoverable components are counted as part of its return. The balance sheet expands to include time.

What if CO₂ emissions are taxed?

As carbon pricing and border adjustments spread across Europe, the embodied emissions of building materials will carry a direct cost. Every tonne of CO₂ embedded in concrete, steel, or aluminium becomes a financial liability. In this context, circular construction and timber hybrids gain a structural advantage: their lower embodied emissions translate into reduced tax exposure. Once environmental cost enters the accounting model, reuse shifts from moral argument to market logic.

What if storage was priced as future investing?

Material storage is often framed as an inefficiency, yet time itself can add value. Holding components between projects entails cost—space, management, insurance—but also opportunity. Material prices can rise during that period, and guaranteed availability prevents costly delays. Examples such as RE:BORN show how stored materials have appreciated beyond their original valuation, turning inventory into investment. In a circular economy, logistics are not just an expense but a temporal form of capital.

Each of these “what ifs” turns a conventional risk into a design variable. They reveal that the viability of circular construction lies not only in new materials but in new models of value creation.

As fiscal systems evolve, as carbon and material costs are internalized, and as storage and verification mature, the advantages of reuse will become self. Rebuilt Building is a prototype for that near-present operating within uncertainty, translating volatility into stability and externalities into assets.



The design of a Rebuilt Building

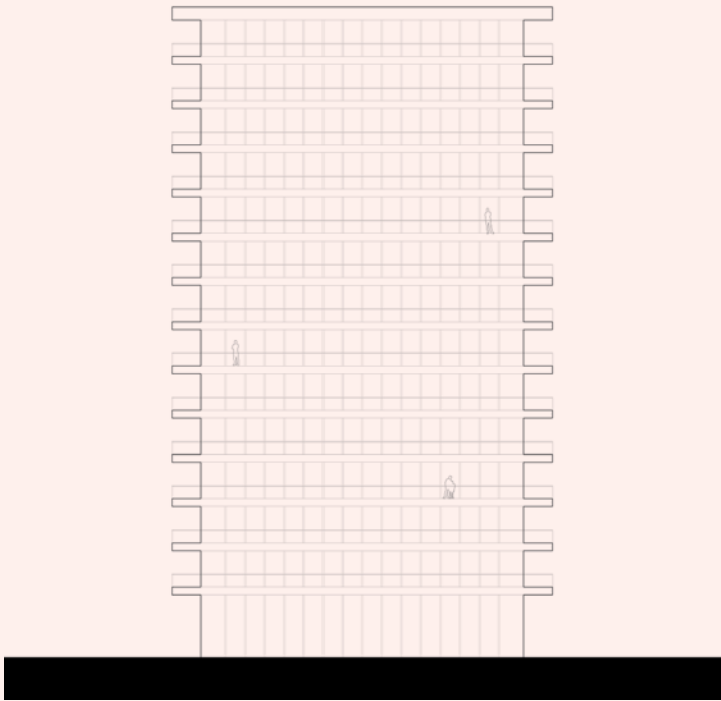


Fig. 61. Elevation of the Rebuilt Building

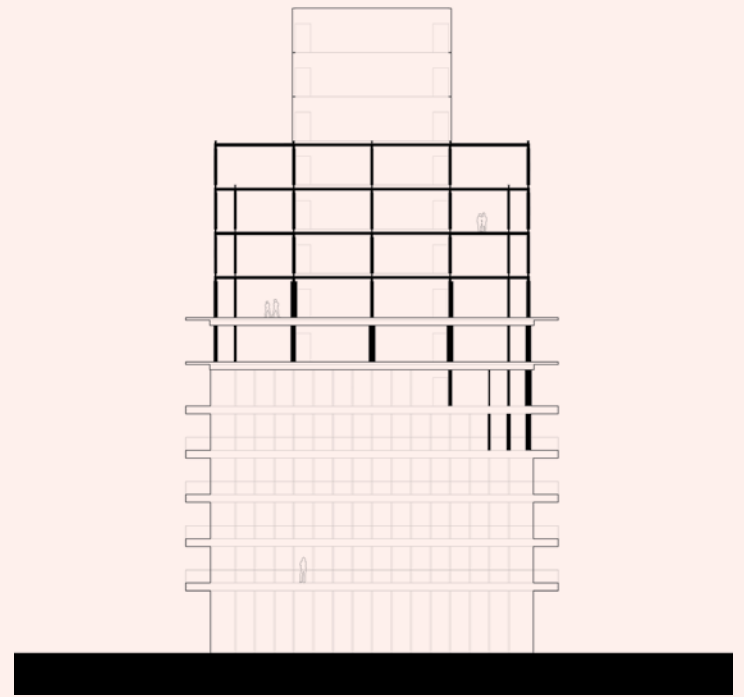


Fig. 62. Construction of the Rebuilt Building

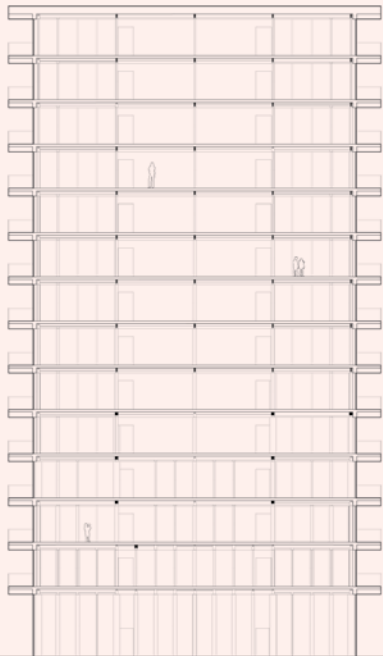


Fig. 63. Section of the Rebuilt Building

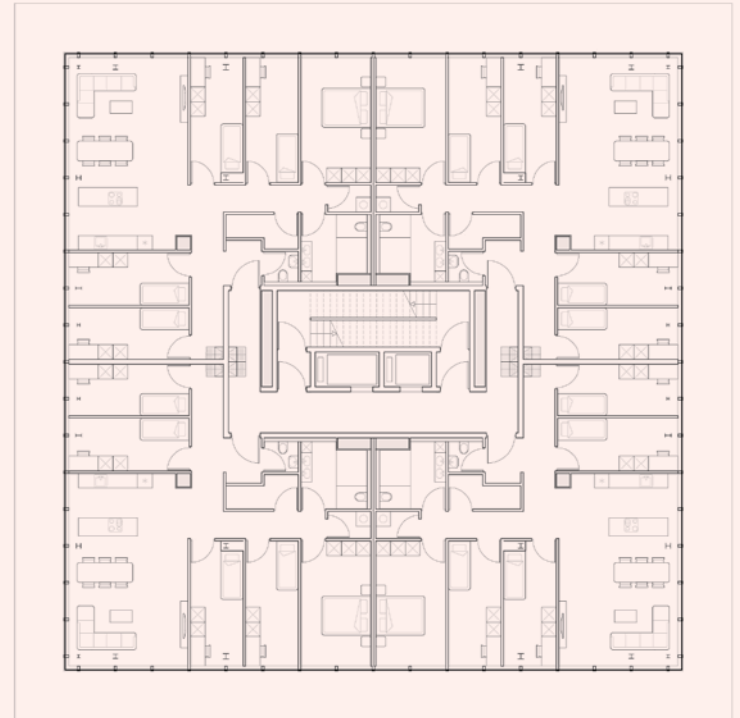


Fig. 64. Floorplan – Level 14

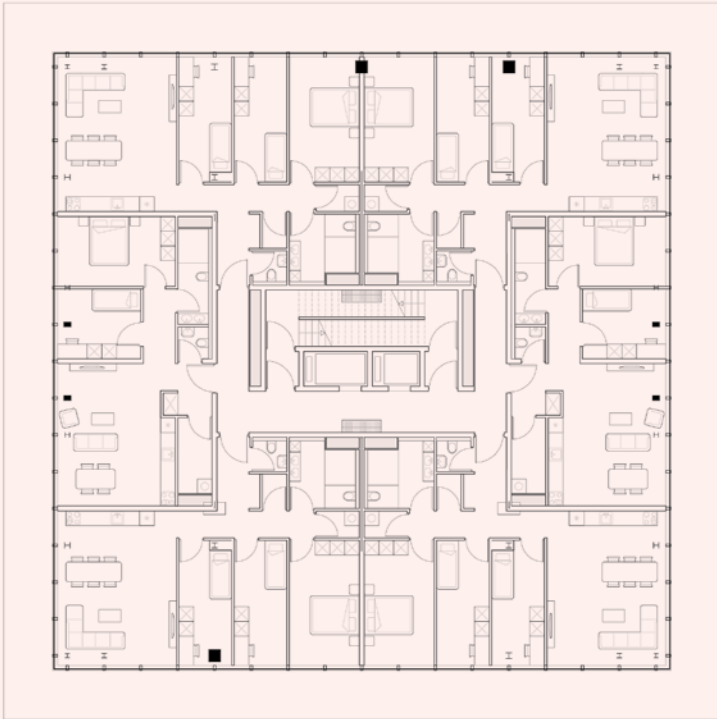


Fig. 65. Floorplan – Level 8

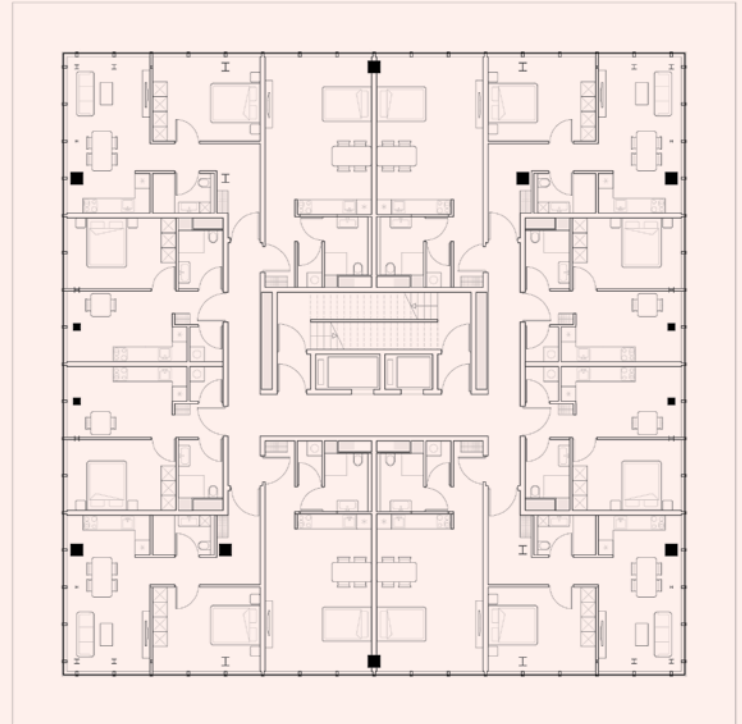


Fig. 66. Floorplan – Level 4

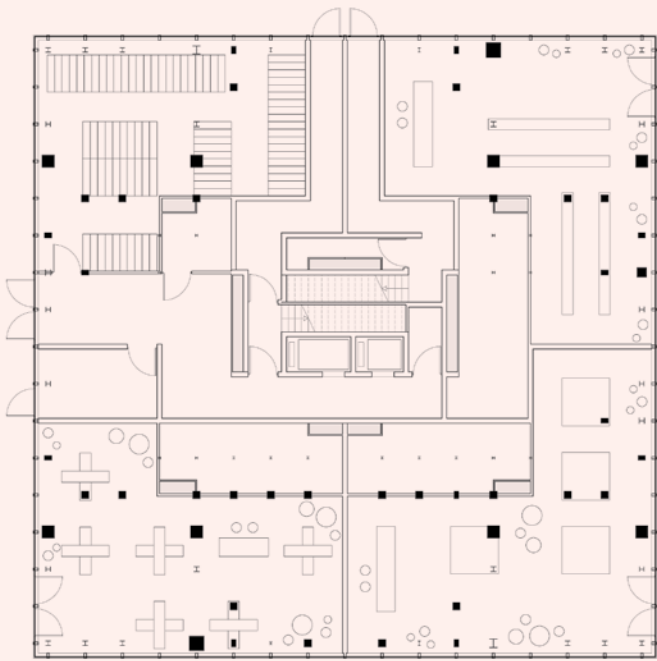
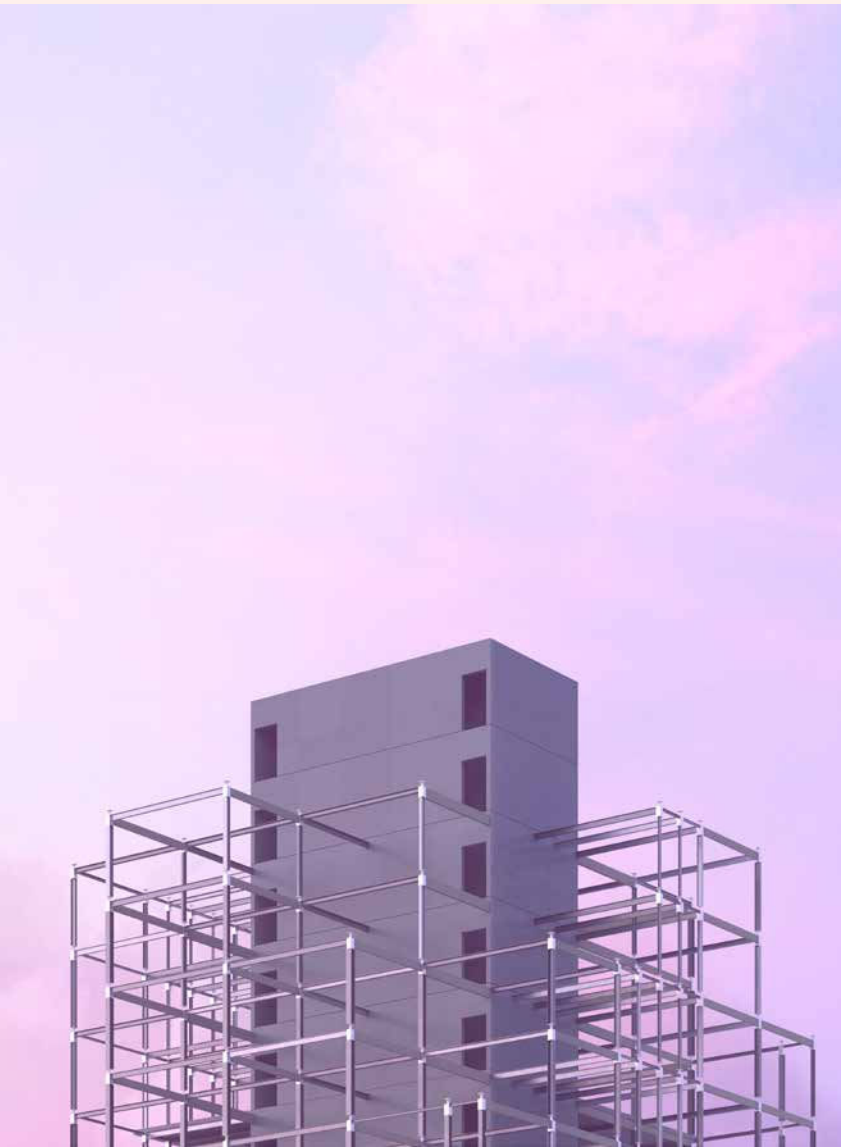


Fig. 67. Floorplan – Level 0









**What to 3
imagine to
Rebuild
Buildings?**

3.1 What's next

This research has focused primarily on conceptual and strategic foundations for circular construction. As explained throughout this report, Rebuilding Buildings is more than just a technical challenge. It involves the creation of new relationships between stakeholders with emerging business models and alternative ownership structures. To expand Rebuilt Buildings in scale and in capacity of delivering common good, several areas remain open for further exploration.

Technological tooling – The digital scripts are developed and are real. These will be made open-source to allow for adaptation and further developments by others. The goal was to create a real time link between structure and available components. The second step would be to make that scripting recursive. The different structural strategies can be assessed and a path to be chosen to what is the most efficient use of resources, not only in material terms but also in societal costs. That would mean to create a framework for multi-criteria decision making, balancing first and second-degree impacts, like costs, maintenance of material integrity, floor plan suitability, emissions avoided, effects of transportation, ...

Technical scope – Rebuilt Buildings is focusing on the (re) construction of the structural aspects of a building. The present research shows the level of complexity involved in imagining of Rebuilding Buildings as a solution at scale. Additional scope and building layers can be added to the study. In certain of these elements, solutions are already market-ready as requiring a more product scale and less capital intensive. For instance, ventilation-as-a-service is already explored as a product for long term investment in modular systems. Beyond structure, it is about exploring what lies ahead, not that the wheel needs to be re-invented every time.

Administrative depth – When going from a research design to an implemented building, many elements are being uncovered as concrete elements to be solved. Some of these elements are known unknowns. For instance, how is the insurability of reused building components conducted with development investors? How is that perceived as potential liability for the credit lenders of future homeowners? While research can be thorough to have a wide and clear overview of the uncertainty's landscape, some of these elements can only be discovered through implementation, by experiencing the real-life friction between stakeholders driven by their own agency. Through implementation, it remains to be seen what are these unknown unknowns.

The next step is to shift from building for future reusability to practicing it through pilots, prototypes, and iterative design. Rebuilt Buildings becomes real only when uncertainty is worked through in practice, until the circularity of materials is no longer the exception but the baseline of how we care for what we build.

3.2 Long projections

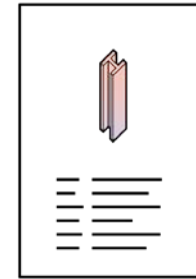
If Rebuilt Buildings has so far focused on practice in today's context and near-term feasibility, this chapter stretches the horizon further. What would it take for circular construction not just to exist in isolated projects, but to become the default logic of the built environment?

To imagine this future means rethinking accounting, ownership, organization, and governance, recasting not only how buildings are made, but how value, responsibility, and stewardship are distributed across society.

These provocations also reach beyond the remit of designers and builders: they expose gaps for policymakers, planners, and entrepreneurs to address, pointing toward the broader infrastructures that must be assembled if circularity is to become systemic.

➤ **Augmented accounting**

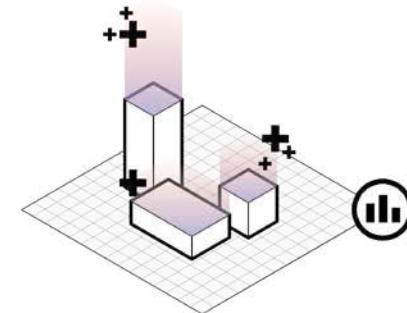
The economics of circular construction must fundamentally rethink the definition of cost and value. Today's construction accounting narrowly focuses on initial investment. Cost is synonymous with what is on the balance sheet of the actor developing the project alone, ignoring systemic externalities such as environmental degradation, health costs from pollution, and missed opportunities for community wealth creation.



① **More-than-Carbon accounting.**

Future accounting models must embody holistic value, incorporating not only the residual economic value of material, but also material and ecological value of materials as common material assets rather than financial expenses.

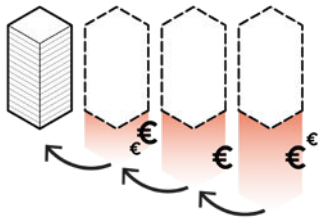
Inspired by initiatives like Amsterdam's Doughnut Economics and Madaster's material passports, future financial systems could utilize holistic balance sheets that include carbon sequestration, circularity indexes, and social cohesion metrics, incentivizing long-term thinking over immediate financial return.



② **Cumulative values.**

There is a need for accounting tools to integrate and aggregate material and environmental impact data from individual components to systems, to buildings, to cities; to identify local material stocks and track their flows, from the scale of a door handle to a city's material economy.

The use of carbon taxes and potential future implementation of national Carbon Treasuries — public institutions responsible for the national allocation and management of carbon emissions and sequestrations — would require robust, shared datasets for each key industrial sector. With the built environment being a significant contributor to carbon emissions, a sector wide national database of emissions attributed to buildings and their constituent materials, would help efforts to introduce more accurate carbon accounting.



③ Analyzing future liabilities

More accurately modelling the depreciation of built assets to assess their future value (including the associated liabilities) could support a new economy for both durable and regenerative materials, in-centivizing the reuse of materials at their highest utility.

↗ Organized chain of custodianship

When the material reality of construction is decoupled from its artificial financial representation, one can then wonder how to maintain the embodied values of all material construction. That in turn requires new narratives of what does it means to build today.

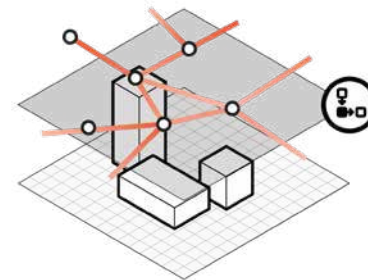


④ Material commons

One of these alternative narratives can be put as: what if the materials used in the construction of the house are leased instead of owned? A fully circular economy that avoids resource depletion has indisputably greater value than our current model of unsustainably extracting new resources without considering their subsequent reuse. How this full circularity emerges will require a system-level infrastructure for enforcing the long-term responsibilities of possessing materials.

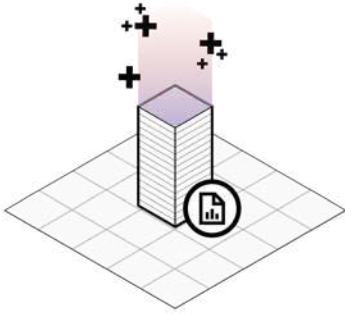
With that in mind, it would require to reimagine the chain of custodianships in its entirety. Who is the owner of the material component? How is it legally framed? What is the path?

At the scale of our homes, the bricks, steel, and timber in existing buildings should be treated as carbon and material stores that need to be reused as much as possible. We need to collectively rethink what it means to live regeneratively in our neighborhoods, by establishing alternative ownership and stewardship models for buildings and their materials and using policy to increase specification of long-life and bio-based materials.



② Alternative Organizations

Circular construction demands entirely new organizational forms, shifting from rigid hierarchies towards fluid, networked entities capable of continuous knowledge sharing and collective decision-making. Future organizations might resemble open-source software networks or decentralized autonomous organizations (DAOs), facilitating transparent, real-time coordination of resources and risks among diverse stakeholders.

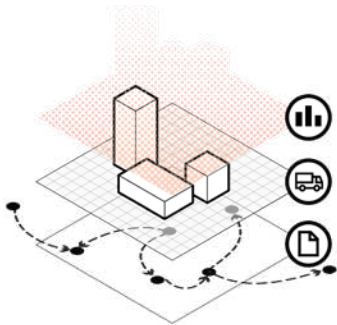


③ Performance contracting

Performance-based regulation and contracting of space: Better building data could enable more agile regulation of the construction and use of buildings, based on their performance or outcomes they contribute to. In the future, this could enable the taxation of underutilized assets or those that do not contribute to public value

➤ Materializing institutions

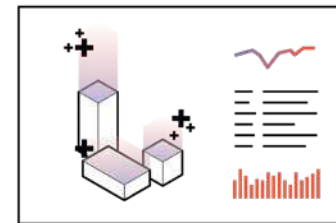
Scaling circular construction requires new institutions designed for orchestration rather than mere regulation.



④ Material Governance

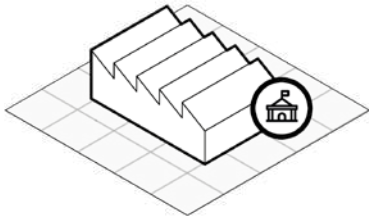
Inspired by the Dutch "Waterschap"—water boards democratically managing regional water infrastructure—we can imagine a parallel structure focused on material preservation. A "Materiaalschap" could democratically manage urban material stocks, enforcing long-term

accountability for the preservation and reuse of materials. Institutions such as an Urban Materials Exchange could resemble sophisticated trading platforms, dynamically matching supply from demolition projects with demand from new construction sites. A complementary Material Authority might act as orchestrator, defining reuse certification standards, coordinating cross-industry collaboration, and managing real-time logistics. Analogous institutions from finance—such as stock exchanges and cooperative banks—offer valuable structural lessons for transparency, trust, and efficient resource matching. While this may sound at odds with the decentralized, networked organizations described earlier, the reality is that circular construction at scale will require both. Flexible, distributed forms of collaboration enable innovation and responsiveness, while coordinating institutions provide the trust, standards, and long-term accountability that networks alone cannot sustain. The real design challenge is to choreograph the interplay between the two.



② Material Monitor

Tools like Amsterdam's Monitor, which tracks urban material flows and associated environmental impacts, could underpin these institutions, enabling cities to monitor progress toward circularity and sustainability goals. Embedding sustainability structurally into municipal operations and budgets through mechanisms like the Planning & Control cycle further integrates responsibility, moving sustainability beyond isolated initiatives into core governance frameworks.



③ Public Sector Storage

Municipalities in cities like Amsterdam and Brussels are experimenting with material depots for public projects. These depots act as collective reservoirs, allowing cities to capture value from dismantled buildings and redistribute components for future use. Beyond providing logistical support, they signal a shift in the role of the public sector—from regulator and client to active custodian of material flows. In time, such depots could evolve into strategic reserves, stabilizing supply chains, reducing costs for public works, and ensuring that the common material heritage of the city remains in circulation rather than being lost as waste.

The futures sketched here are prompts suggesting that making circular construction real will depend on more than perfecting technical fixes but also on creating the institutions, organizations, and custodianships that can hold materials in common over time. The task is to design these frameworks as carefully as we design buildings themselves, because without them, reuse will remain a series of pilots rather than the foundation of a new building culture.

Call for continuation

Rebuilt Buildings documents a complete design process for working with reused structures under current conditions. Its diagrams, parametric tools, and methods are shared as open resources, not as finished answers but as material that can be tested, adapted, and extended. The project operates as research by design, tracing what it takes—technically, economically, and institutionally—to plan a building when material reuse is treated as a starting point rather than an exception.

Following this process made clear that the main constraints do not sit in the structure alone. Planning frameworks, financial models, logistics chains, and certification practices all shape whether reuse remains marginal or becomes repeatable. Moving from a single project to broader application therefore depends less on new concepts than on how existing roles choose to act within their respective spheres.

National governments

Reuse delivers on climate-transition mandates by slashing embodied carbon and import dependence. Writing minimum-reuse targets into building codes and funding regional material depots turns ambition into infrastructure.

Local authorities

Cities aiming for circularity can publish geocoded demolition schedules, reserve industrial plots for material hubs, and reward high-reuse bids in public tenders, translating policy goals into tangible material flows.

Real-estate developers & long-term investors

Adaptive procurement hedges against price shocks and emerging carbon taxes. Piloting even a single reuse-first project per pipeline cycle converts ESG commitments into durable, high-performing assets.

Building owners

The first duty is to maintain existing buildings at the highest possible level of integrity. Where renewal is unavoidable, owners can document and market their components so that materials become tradable assets rather than disposal costs.

Digital platforms & data providers

Open marketplaces, component passports, and real-time tracking services lower transaction friction. Standardized metadata and verified performance records accelerate both certification and design uptake.

Built-environment practitioners

engineers, architects, hubs, logistics providers, contractors – New service lines emerge in testing, tracking, and specialized assembly; by normalizing passports, tolerances, and installation protocols, practitioners shift reuse from one-off to everyday.

What Rebuilt Buildings offers is not a template to be replicated, but a set of methods and observations that can be taken further by others. Its relevance will be tested in how these tools are adapted, adjusted, and applied across different contexts.



The future of Rebuilding Buildings



Disassembly

The reuse component starts its journey by being extracted from its host building during disassembly



Transport

The reusable materials are being transported from the site to the facility where they will be prepared for a new life-cycle



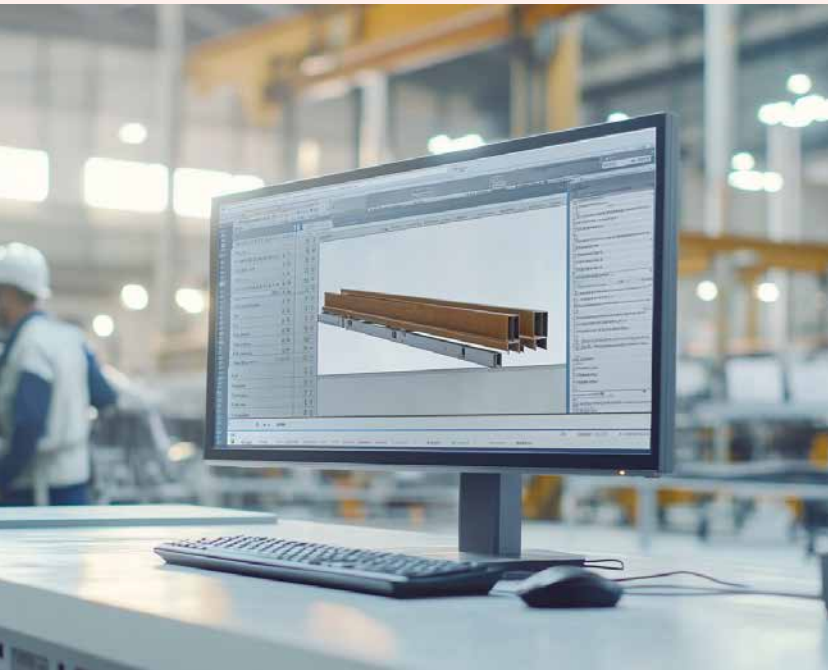
Classification and storage

After a first typological classification of the component, the component awaits further steps in the intermediary storage



Certification

In the next step, the component is manually investigated and structurally tested, to confirm its useability in new construction



Material passport

After the usability of the component is confirmed, a material passport is created to facilitate further reuse in future life-cycles



Restoration

For its immediate next application, the component is uplifted and prepared according to its purpose



Transport

The component leaves the facility towards its new destination, a construction site for a new building



Rebuilt building

The component is reused in a new structure, continuing its journey within the material loop for decades to come

Appendix 1 – Data for storage logistics Urban Miner

Transport mode	Box Truck	Truck Mounted Crane	Boat
CO ₂ /km	Empty 200 g CO ₂ /KM Full 375 g CO ₂ /km	Empty 700 g CO ₂ /KM Full 1050 g CO ₂ /KM	Electric: 0 Diesel: 40 KG CO ₂ /HOUR
Cost/per hour	Electric: 105 euro per hour Diesel: 95 euro per hour	Electric: 145 euro per hour Diesel: 115 euro per hour	Electric: 1450 per day Diesel: 1100 per day
Max dimension of elements	Length 9 meters Height 3 meters Width 2.4 meters	Length 9 meters Height 1 meters Width 2.4 meters	max 10 ton
Capacity (m ³ /trip)	50m ³ →real 30m ³	20m ³ -50m ³	max 10 ton
Specific permit?	Milieuzones	Gewichtvergunning Milieuzones Ontheffings- exceptioneel transport	Milieuzones
Remarks?	Electrical range 180 KM	Electrical range 120 KM and limited crane capacity	The project must be located by the water.

Appendix 2 – In practice, applied data Rebuilt Building for transport logistics

Steel elements	1700	m ² footprint	
Concrete elements	300	m ² footprint	
Total footprint elements	2000	m ² footprint	
	To hub	To site	
Transport trips	50	trips	
Transport distances	180	150	km/trip
Transport duration	3	2.5	h/trip
Transport costs	56700	39400	eur
	96100		eur
Transport CO ₂ footprint	3375	2812.5	kg CO ₂
Total	6187.5		kg CO ₂
Parameters			
Electric truck full capacity	21.6	m ² /trip	
Stacked trans-ported elements	4	layers	
Spatial efficiency	85%	%	
Electric truck costs	105	eur/h	
Electric truck CO ₂ footprint	0.375	kg CO ₂ /km	

Appendix 3 – In practice, applied data Rebuilt Building for storage logistics

Steel elements	1700		m ² footprint
Concrete elements	300		m ² footprint
Total footprint elements	2000		m ² footprint
	Outdoor	Indoor	
Storage duration	12		months
Storage space	850	150	m ²
Storage costs	61200	21600	eur
Total	82800		eur
Parameters			
Stacked stored elements	4		layers
Spatial efficiency	50%		
Storage costs	6%	12%	eur/m ² *month

Hier uitgesplits verkoopopbrengsten en overige kosten (concept) →

Appendix 4 – In practice, construction costs breakdown for the different scenarios

	Concrete	Timber	Rebuilt Building
Bouwkosten schatting	€ 2000-2300	€ 2400-2900	€ 3000-4000
Bouwkosten nu	€ 2,278	€ 2,604	€ 3,100
Structure (primaire draagconstructie)	€ 8,350,000	€ 10,850,000	€ 13,750,000
	41.2%	46.9%	49.9%
→Funderingen	€ 2,000,000	€ 1,750,000	€ 2,035,000
→Dragende vloeren	€ 2,750,000	€ 3,500,000	€ 4,290,000
→Dragende wanden Kolommen & balken	€ 1,500,000	€ 3,200,000	€ 3,575,000
→Kolommen & balken	€ 1,500,000	€ 1,750,000	€ 2,475,000
→Stabiliteitsvoorzieningen	€ 550,000	€ 650,000	€ 1,375,000
Skin (gevel + dak)	€ 4,250,000	€ 4,650,000	€ 5,390,000
	21.0%	20.1%	15.4%
→Gevelafwerking & isolatie	€ 2,100,000	€ 2,500,000	€ 3,025,000
→Ramen, kozijnen, glas	€ 1,600,000	€ 1,600,000	€ 1,760,000
→Dakconstructie & bedekking	€ 550,000	€ 550,000	€ 605,000
Services (installaties)	€ 3,850,000	€ 3,850,000	€ 4,235,000
	19.0%	16.6%	15.4%
→HVAC-systemen	€ 1,600,000	€ 1,600,000	€ 1,760,000
→Elektrotechniek	€ 1,100,000	€ 1,100,000	€ 1,210,000
→Sanitair & riolering	€ 750,000	€ 750,000	€ 825,000
→Liftinstallaties	€ 400,000	€ 400,000	€ 440,000
Space Plan (indeling & afwerking)	€ 3,800,000	€ 3,800,000	€ 4,180,000
	18.8%	16.4%	15.2%
→Binnenwanden & deuren	€ 1,200,000	€ 1,200,000	€ 1,320,000
→Plafondafwerking	€ 650,000	€ 650,000	€ 715,000
→Vloerafwerking	€ 900,000	€ 900,000	€ 990,000
→Wandafwerking	€ 550,000	€ 550,000	€ 605,000
→Overig	€ 500,000	€ 500,000	€ 550,000
Bouwkosten (BK) totaal	€ 20,250,000	€ 23,150,000	€ 27,555,000
	100%	100%	100%
		14%	14%

Appendix 5 – In practice, business cases and full costs for the different scenarios

		Concrete	Timber	Rebuilt Building
Construction		€ 20,250,000.00	€ 23,150,000.00	€ 27,555,000.00
Planning fees	of construction	18.0%	18.0%	18.0%
		€ 3,645,000.00	€ 4,167,000.00	€ 4,959,900.00
Development	of construction + planning + land	15.0%	15.0%	15.0%
		€ 5,025,000.00	€ 5,538,000.00	€ 6,318,000.00
Financing	of construction + planning + land + financing	7.5%	7.5%	7.5%
		€ 2,889,000.00	€ 3,185,000.00	€ 3,633,000.00
Land		€ 9,600,000.00	€ 9,600,000.00	€ 9,600,000.00
Other		€ 2,071,000.00	€ 2,282,000.00	€ 2,604,000.00
Material residual value		0%	0%	15%
		€ -	€ -	€ 4,133,250.00
Units sale		100%	105%	110%
		€ 46,500,000.00	€ 48,825,000.00	€ 51,150,000.00
Costs		€ 43,480,000.00	€ 47,922,000.00	€ 54,669,900.00
		100%	+10%	+26%
Revenues		€ 46,500,000.00	€ 48,825,000.00	€ 55,283,250.00
		100%	+5%	+19%
Delta		€ 3,020,000.00	€ 903,000.00	€ 613,350.00

Appendix 6 – In practice, environmental balance for the different scenarios

		A – Concrete	B – Timber hybrid	C – Re-use hybrid
Structure	PPm (kg CO ₂ eq/m ² BVO) ¹	128	81	53
	MPG (MPG per m ² BVO/year)	0,200	0,084	0,073
Core+ foundations	PPm (kg CO ₂ eq/m ² BVO) ²	73		
	MPG (MPG per m ² BVO/year)	0.132		
	Core	0.096		
	Foundations	0.036		
Skin	PPm (kg CO ₂ eq/m ² BVO) ¹	42		
	MPG (MPG per m ² BVO/year)	0.092		
Space plan	PPm (kg CO ₂ eq/m ² BVO) ¹	30		
	MPG (MPG per m ² BVO/year)	0.066		
Services	PPm (kg CO ₂ eq/m ² BVO) ¹	35		
	MPG (MPG per m ² BVO/year)	0.078		
Total	PPm (kg CO ₂ eq/m ² BVO) ¹	308	261	233
	MPG (MPG per m ² BVO/year)	0,567	0,451	0,440

Sources

i

Carl Elefante. 2007. The Greenest Building Is...One That Is Already Built. *Forum Journal* 21(4), 26-38.

ii

Michaël Thyoot, Tom Schoonjans. Break the cycle: the limits of circular construction. *The Architectural Review - May 2025: Circularity*. Accessed March 3, 2026. <https://www.architectural-review.com/essays/break-the-cycle-the-limits-of-circular-construction>

iii

Ibid.

iv

Charlotte Malterre-Barthes. 2025. A Moratorium on New Construction. London: Sternberg Press.

v

Vanessa Plumwood. 2008. Shadow places and the politics of dwelling, *Australian Humanities Review* 44 (2), 139-150.

vi

Keller Easterling. 2014. *Subtraction*. Edited by Nikolaus Hirsch and Markus Miessen, London: Sternberg Press.

1a

World Green Building Council. 2021. *WorldGBC Net Zero Carbon Buildings Commitment expands to include embodied carbon*. Accessed January 5, 2026. <https://worldgbc.org/article/worldgbc-net-zero-carbon-buildings-commitment-expands-to-include-embodied-carbon/>

1b

Dutch Green Building Council. 2021. *Position Paper Whole Life Carbon*. Accessed January 5, 2026. <https://cms.acquire.nl/storage/ckfinder/files/Position%20Paper%20Whole%20Life%20Carbon%20-%20DGBCC.pdf>, p. 5.

1c

Ibid., p. 5.

2a

International Resource Panel. 2024. *Global Resources Outlook 2024: Bend the Trend – Pathways to a Liveable Planet*. Nairobi: United Nations Environment Programme.

2b

Ibid.

3a

European Commission. 2025. *Construction and Demolition Waste*. Accessed January 5, 2026. https://environment.ec.europa.eu/topics/waste-and-recycling/construction-and-demolition-waste_en

3b

Bergsma, Geert, and Marijn Bijleveld. 2015. *Hard Facts on the Dutch Construction Sector*. Delft: CE Delft. Accessed January 5, 2026. <https://cedelft.eu/publications/hard-facts-on-the-dutch-construction-sector/>

4

Statistics Netherlands (CBS). 2024. *Input Price Indices Building Costs: New Dwellings 2015=100, 2012–2023*. Accessed January 5, 2026. <https://www.cbs.nl/en-gb/figures/detail/83887eng>

5

European Commission. 2025. *Centralised Planning to Increase Housing Supply: Netherlands Housing Target*. Accessed January 5, 2026. https://commission.europa.eu/projects/centralised-planning-increase-housing-supply_en

6

Hagens, Nate J. 2020. *Economics for the Future – Beyond the Superorganism*. *Ecological Economics* 169 (March): 106520. Accessed January 5, 2026. <https://doi.org/10.1016/j.ecolecon.2019.106520>

7

Statistics Netherlands (CBS). *Voorraad woningen; standen en mutaties vanaf 1921 tot 2024*. Dataset 82235NED. Accessed January 5, 2026. <https://opendata.cbs.nl/#/CBS/nl/dataset/82235NED/table>

8

Ibid.

9

Delahaye, Roel, Marieke Rensman, and Adam Walker. 2023. *Structural Changes in Material Flows from the Mid-20th Century in the Netherlands: Material Use Related to Climate Change*. Voorburg/Heerlen: Statistics Netherlands (CBS). Accessed January 5, 2026. https://www.cbs.nl/-/media/_pdf/2023/46/dutch_material_flows_from_1950.pdf

10

Ibid.

11

Ibid.

12

Statistics Netherlands (CBS). *New dwellings; input price indices building costs 2000 = 100, from 1990*. Accessed January 5, 2026. https://www.cbs.nl/en-gb/figures/detail/80444eng#PriceIndices_5

- 13**
Delahaye, Roel, Marieke Rensman, and Adam Walker. 2023. *Structural Changes in Material Flows from the Mid-20th Century in the Netherlands: Material Use Related to Climate Change*. Voorburg/Heerlen: Statistics Netherlands (CBS). Accessed January 5, 2026. https://www.cbs.nl/-/media/pdf/2023/46/dutch_material_flows_from.1950.pdf
- 14**
Rijksoverheid. 2018. *Circular Economy: What We Want to Know and Can Measure: Framework and Baseline Assessment for Monitoring the Progress of the Circular Economy in the Netherlands*. The Hague: PBL Netherlands Environmental Assessment Agency (in cooperation with CBS and RIVM). Accessed January 5, 2026. <https://www.pbl.nl/sites/default/files/downloads/pbl-2018-circular-economy-what-we-want-to-know-and-can-measure-3217.pdf>, p. 8.
- 15**
Bergsma, Geert, and Marijn Bijleveld. 2015. *Hard Facts on the Dutch Construction Sector*. Delft: CE Delft. Accessed January 5, 2026. <https://cedelft.eu/publications/hard-facts-on-the-dutch-construction-sector/>
- 16**
Compendium voor de Leefomgeving (CLO). 2020. *Bouw- en sloopafval: vrijkomen en verwerking, 1985–2018*. Accessed January 5, 2026. <https://www.clo.nl/indicatoren/nl014712-bouw-en-sloopafval-vrijkomen-en-verwerking-1985-2018>
- 17**
European Environment Agency. 2025. *Circular Material Use Rate: Netherlands*. Accessed January 5, 2026. <https://www.eea.europa.eu/en/europe-environment-2025/countries/netherlands/circular-material-use-rate>
- 18**
Circle Economy Foundation and Deloitte. 2023. *Circularity Gap Report 2023*. Accessed January 5, 2026. <https://www.circularity-gap.world/2023>
- 19**
Ibid.
- 20**
Rijkswaterstaat. 2018. *Nederland Circulair in 2050: Grondstoffen in de Gebouwde Omgeving*. The Hague: Ministry of Infrastructure and Water Management.
- 21**
Rijksoverheid. 2023. *Nationaal Programma Biobased Bouwen*. The Hague: Government of the Netherlands. Accessed January 5, 2026. <https://www.rijksoverheid.nl/documenten/rapporten/2023/11/08/nationale-aanpak-biobased-bouwen>
- 22**
Rijkswaterstaat. 2018. *Nederland Circulair in 2050: Grondstoffen in de Gebouwde Omgeving*. The Hague: Ministry of Infrastructure and Water Management.
- 23**
Brand, Stewart. 1994. *How Buildings Learn*. London: Penguin Books.
- 24**
Wikipedia contributors. 2026. MacGuffin. *Wikipedia, The Free Encyclopedia*. Last modified January 5, 2026. <https://en.wikipedia.org/wiki/MacGuffin>.
- 25**
Hill, Dan. 2012. *Dark Matter and Trojan Horses: A Strategic Design Vocabulary*. Moscow: Strelka Press, p. 51–53.
- 26**
"Arnoldussen, Jelger, Samira Errami, Radislav Semenov, Gerard Roemers, Merlijn Blok, Martijn Kamps, and Kees Faes. 2020. *Materiaalstromen, milieupact en energieverbruik in de woning- en utiliteitsbouw: Uitgangssituatie en doorkijk naar 2030. Rapport, Stichting Economisch Instituut voor de Bouw (EIB), Metabolic, and SGS Search*. Accessed January 5, 2026. <https://circulairebouwconomie.nl/wp-content/uploads/2020/02/Rapport-Materiaalstromen-in-de-woning-en-utiliteitsbouw-klein.pdf>, p. 60."
- 27**
Tsui, Tanya, Petar Koljenšić, Tim van Binsbergen, Jip Kuiper, Walther Ploos van Amstel, and Ruben Vrijhoef. 2025. *Logistics for Building Circular, Biobased, and Modular: Environmental Impacts in Amsterdam*. *Journal of Circular Economy* 3 (4): 23–41.
- 28**
CircuLaw. 2026. *Gebruik de sloopmelding om materiaalstromen inzichtelijk te maken*. Accessed January 5, 2026. <https://www.circulaw.nl/bouw/infra/instrumenten/gebruik-de-sloopmelding-om-materiaalstromen-inzichtelijk-te-maken/>
- 29**
Rijkswaterstaat, Ministerie van Infrastructuur en Waterstaat. n.d. *Voortgezet gebruik*. Accessed January 5, 2026. <https://afvalcirculair.nl/afvalstof-of-niet-afvalstof/voortgezet-gebruik/>
- 30**
Netherlands. Environmental Management Act (Wet milieubeheer) / Environmental Law (Omgevingswet), provisions on waste storage and treatment (storage prior to recovery within three years). Cited via Maak Law, *Waste Management Regulations in the Netherlands*. Accessed January 5, 2026. <https://www.maak-law.com/product-compliance-netherlands/waste-management-regulations-netherlands/>
- 31**
ZHAW School of Architecture, ed. 2022. *Reuse in Construction: A Compendium of Circular Architecture*. Zurich: Park Books.
- 32**
Ibid., p. 252.
- 33**
Ibid., p. 250.
- 34**
Ibid., p. 260.
- 35**
Ibid., p. 258.
- 36**
Raworth, Kate. 2017. *Doughnut Economics: Seven Ways to Think Like a 21st-Century Economist*. London: Random House Business.
- 37**
Madaster. 2024. *Material Passport*. Accessed January 5, 2026. <https://madaster.com/material-passport/>

Credits

Collaborators

→Superworld

An architecture and strategic design practice exploring the operating systems of the built environment, with a focus on circularity, environmental transition, and alternative development models.

www.superworld.nl

→Summum Engineering

A structural design and optimization consultancy specializing in biobased, lightweight, and circular materials, as well as digital fabrication.

<https://www.summum.engineering/>

→Urban Miner

A circular construction hub facilitating the sourcing, storage, and redistribution of reclaimed building components for construction and infrastructure projects.

<https://www.duravermeer.nl/dura-vermeer-urban-miner>

→C'MON

A new generation real estate developer working towards systemic change in the built environment. Circularity is our baseline – our ambition is to build regenerative, community-led places.

<https://www.cmon.world/>

→DGMR

A consultancy and engineering firm advising on innovative, low-carbon, circular, and healthy building solutions.

<https://www.dgmr.nl/>

Roles

Initiation & Strategic Design – Maxime Cunin (Superworld)

Initiation & Architectural Design – Thomas Krall (Superworld)

Structural Parametric Design & Engineering – Alessio Vigorito, Diederik Veenendaal, Anand Shah (Summum Engineering)

Material Infrastructure & Logistics – Ali Sedaghat Tarigheh (Dura Vermeer – Urban Miner)

Circular Real Estate Strategy – Lena van der Wal, Marcella Wong (C'MON)

Sustainability & Technical Advisory – Laura van de Pol, Jean Frantzen (DGMR)

Interviews

Menno Rubbens (cepezed) – <https://www.re-born.com/>

Raouf Jarmo (RE:BORN) – <https://www.cepezed.nl/>

Jan Jongert (Superuse Studios) – <https://www.superuse-studios.com/>

Production

Text, Research & Diagrams by Superworld

Images by Imprfct* – <https://www.imperfct.com/>

Publication Design by Jannie Guo – <https://jannieguo.com/>

Funding

RVO – Circular Ketensproject

This research was supported by the Circular Ketensproject programme of the Netherlands Enterprise Agency (RVO), which supports cross-sector collaborations that advance circular economy practices and material reuse.

TBI Klimaattrein

The research by Summum Engineering was co-funded by TBI Klimaattrein, a funding programme and collaborative community designed to accelerate progress toward the climate commitments agreed in Paris in 2015."

Contact

For further information on the project and its methods, see: <http://tiny.cc/RebuildBuildings>



In a near future—one that policy-makers increasingly anticipate—old buildings, when not preserved, are deconstructed rather than demolished, and new buildings are assembled from reused materials. But beyond targets and policies, what would it mean to design, source, finance, and construct buildings in this new reality?

Rebuilt Buildings prototypes how to design and construct structures with and for reclaimed materials in the Netherlands. This interdisciplinary research-by-design project develops a practically applicable and economically viable playbook—one that treats logistics, time, and risk as emerging parameters for designers.

A research project initiated by Maxime Cunin and Thomas Krall of Superworld, developed in collaboration with Summum Engineering, Dura Vermeer-Urban Miner, C'MON, and DGMR. Funded by RVO Circulair Ketenproject.

© 2026