THERMAL COLLECTIVES

ARCHITECTURAL IMAGINARIES BEYOND MODERN COMFORT

by

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ABSTRACT

The era of abundance is over.

The urgent need for CO2 emission reductions, combined with the rising price of energy and building materials, as well as restrictions on construction waste, call for alternative modes of building and inhabiting our cities.

The notion of "comfort" implies practices of consumption that have shaped our cultural and sensorial experience of domesticity. But "modern comfort", the one we know today, is a recent construct that was shaped in the aftermath of the post-war economic boom. Modern comfort is characterized by the transition from the tactical heating of human bodies in space to the global and uniform conditioning of spaces themselves —at all times and across all seasons. This was rendered possible by the development of fuel intensive HVAC systems and supported by complex curtain wall envelopes that have resulted in the industry-wide abandonment of thermal intelligence and its associated material practices.

In a near future context of fuel scarcity, a group of people come together to confront the rising difficulty of maintaining their comfort. Their vision for living together in an alternative mode of dwelling calls for new forms of abundance in a world of scarcity, achieved through thermal intelligence. Their manifesto outlines the following fundamentals:

- Living with thermal properties and climate
- Collectivizing living spaces
- Applying thermal intelligence to material ethics in construction and maintenance.

The group surveys the numerous stranded modern office buildings on the outskirts of Paris. They acquire one of them at a bargain, and commission an experienced thermal architect to design the major spatial and infrastructural rearrangements to unlock the building's passive thermal capacity. In support of the Thermal Collective's new way of dwelling, the residents share their skills and build and maintain the interior fit out. We will follow the stories of some of the inhabitants as they construct, live in and care for their Thermal Collective.

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ACKNOWLEDGEMENTS

COMITTEE

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Caitlin Mueller, thank you for helping us confront the technical background of our proposals and speculate with us about the possible futures of energy and buildings. Your enthusiasm for material reuse and the mitigation of building's environmental impact has shaped our time at MIT. Thank you for being a generous and patient mentor and for cultivating a welcoming and uplifting community in the Building Technology group.

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Eytan Levi, for a meticulous last minute proofread, and obviously, for years of friendship, for your critical eye, your passion, and for bringing us three together at MIT!

FOREWORD

This thesis imagines alternative ways of dwelling that rely less on consumerist practices by questioning the modern conception of comfort and offering other lenses through which to imagine qualitative living experiences.

Part 1 investigates the notion of modern comfort, its origins, and the complications it represents today in light of the climate crisis. This part also offers strategies for building and dwelling practices that are tighter to thermality, materials, and collectives.

Part 2 proposes architectural imaginaries that embed these new ways of urban dwelling in a near-future Paris. Here, we will follow stories from a collective of people who gather to construct, live in and care for a new kind of cooperative living.

A list of all figures is provided at the end of this document.
All figures by authors unless otherwise specified.

CONTENTS

COM·FORT *noun*
/ˈkəmfərt/

1. a state of physical ease and freedom from pain or constraint.

2. the easing or alleviation of a person's feelings of grief or distress.

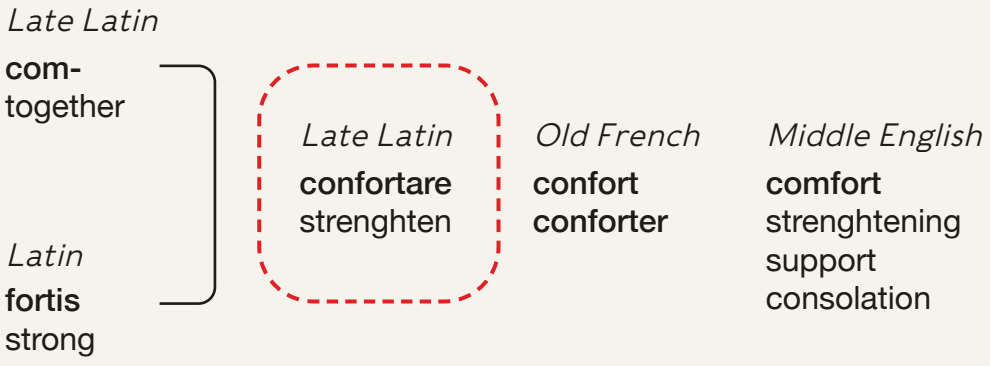
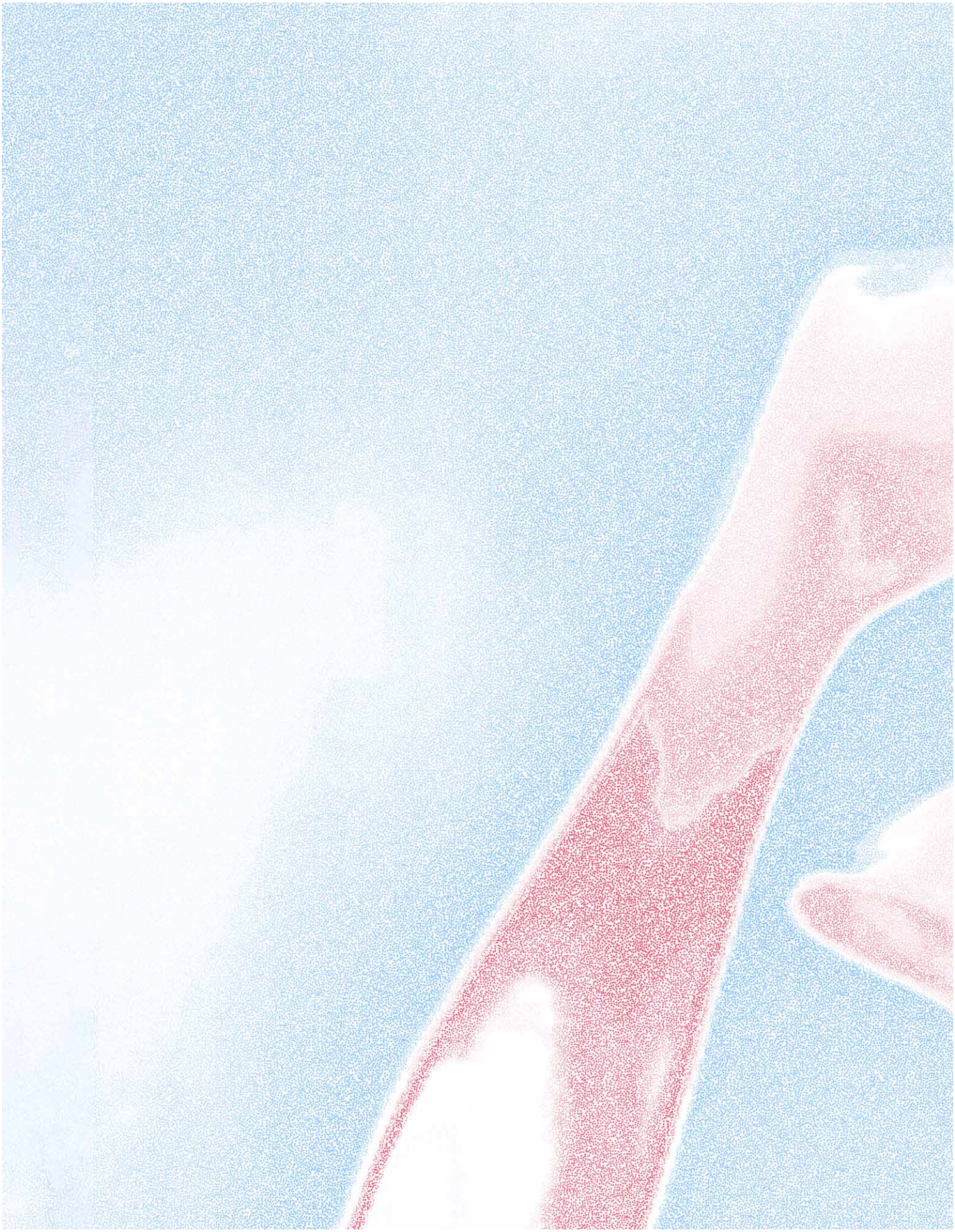


Figure 1. *Comfort and its etymology*



Part 1.

ON COMFORT

THE RISE OF COMFORT

What is (*wrong with*) Comfort?
Postwar boom & Modern Comfort
A Modern typology: office buildings

PARADIGMATIC SHIFT

From Abudance to Sufficiency

TOWARDS A NEW DOMESTICITY

Thermal Intelligence
Material Ethics
Collective Living

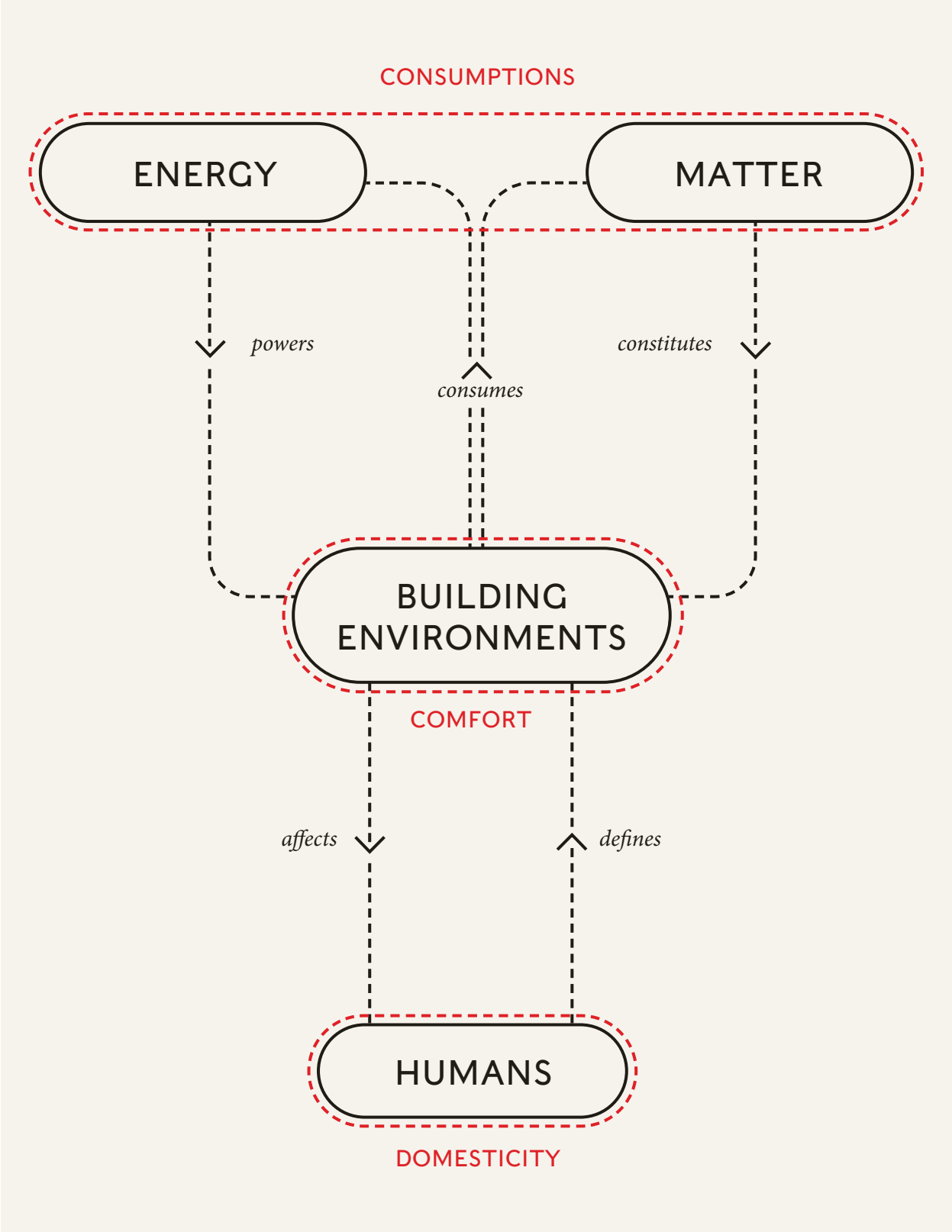


Figure 2. *Diagram of the Energetic and Material contract enacted by buildings environment.*

WHAT IS *(WRONG WITH)* COMFORT ?

Buildings consume a large part of our material and energy resources. As we dwell in them, it's where humans primarily formulate their relationships with matter and energy. **Comfort** is another word for the regime defined by buildings in the material-energetic contract, it implies **consumption practices** but also shapes our **cultural and sensorial experience of domesticity**.

Comfort comes from the Latin *Confortare - something that strengthens*. The current meaning of *domestic* comfort first appeared in the French language in 1842[1], but the actual generalization of **modern thermal comfort** in French homes is only an achievement of the **post-war economic boom** (*les trentes glorieuses*)[2].

Today, **40% of global CO2e emissions** come from the building industry, primarily due to the massive mobilization of extracted materials to build them and the constant flow of energy required to power them. We can no longer sustain the hyper-consumption of modern comfort, which doesn't *strengthen* anymore, but rather *weakens* our position on this planet.

As the bridge between the **affective dimension** of dwelling and the **extractive practices** of consumption, Comfort is the critical ground on which to operate in order to re-imagine our modes of living. Questioning Comfort will come with frictions, but as Daniel Barber reminds us *: We will be discomforted either by design or by default, as the terrors of an uninhabitable Earth make themselves increasingly felt. Why not start now?*

1. *Goubert, Jean-Pierre, Du luxe au confort*
2. *Jandot, Olivier. Les délices du feu: l'homme, le chaud et le froid à l'époque moderne. 2017.*
3. *Daniel Barber, Atfer comfort*

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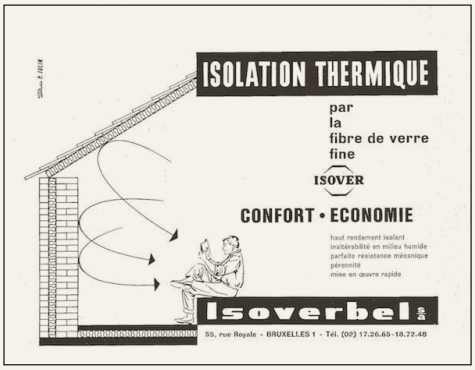

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Figure 3. *Cover of Jean Fourastié's book*
Figure 4. *Ad for electrification of homes*
Figure 5, 6. *Ad for domestic gas*
Figure 7, 8. *Ad for insulation panels*
Figure 9. *Ad for bronze window frames*
Figure 10. *Ad for cellular concrete blocks*

POST WAR BOOM & MODERN COMFORT

Les Trentes Glorieuses[3], is the term cornered by Jean Fourastié to designate the **post-war economic boom** in France. In his eponymous book, Fourastié refers to this period as an invisible revolution that profoundly transformed the population's domestic lifestyle. Before this shift, except in luxurious homes, most people still lived in the *ancient thermal regime*[4] described by Olivier Jandot, principally characterized by thermal **scarcity**.

Slowly but surely, over 30 years, the domestic lifestyle in France was transformed by the introduction of **cheap and abundant fuel** and the **industrialization of building systems** and appliances. This resulted in the global adoption of what we can today call **Modern Comfort**.

Modern Comfort is defined by the transition from the tactical heating of human bodies in space to the global and uniform conditioning of spaces themselves —at all times and across all seasons. It was rendered possible by the development of **fuel-intensive conditioning systems** and sustained by the **complexification of building assemblies**. The advertisements from this period show incentives to **improve comfort** through **energizing homes** and building with **industrial proprietary construction systems**.

By relying primarily on an abundant income of cheap energy and the deployment of industrial building systems, **Modern Comfort** has resulted in the industry-wide abandonment of thermal intelligence and its associated material practices.

3. *Fourastié, Jean. Les trentes glorieuses: ou la révolution invisible*
4. *Jandot, Olivier. Les délices du feu: l'homme, le chaud et le froid à l'époque moderne.*

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Figure 11-12. *Air France offices, 1958-1960 © Centre Pompidou Bibliothèque Kandinsky*

Figure 13. *Caisse centrale de réassurance, 1955-1958 © Pavillon de l'Arsenal*

Images from "Des origines du bureau". S. Nivet

A MODERN TYPOLOGY : OFFICE BUILDINGS

The standards of modern comfort are perfectly embodied in the emergence of a new typology of buildings in the first half of the 20th century: **modern offices**[5]. Breaking away from the traditional compositional exercises of plans and facades, these buildings consist of a vertical **array of concrete slabs** wrapped in a **glass curtain wall**. Geared towards functionalism and standardization, these generic spaces are lined with pristine and abstract **composite materials** praised for their hygienic virtues. Inside, the arrays of cubicles delineated by rows of mobile partitions are kept uniformly comfortable through the introduction of **global conditioning**.

The proliferation of modern office buildings, and the new working spatiality they produce, contribute to strengthening further the expectations of society towards modern comfort. **Functional, private, standard, uniform, hygienic, stable,** and **automated**. In these proto-smart buildings, comfort is granted, and occupants don't need to care anymore about the material and energetic conditions required to produce it. For instance, there is no need to open a window; ventilation and conditioning are fully automated, so windows became increasingly non-operable.

The **conditions of comfort production** become increasingly abstract as the agency of users is progressively taken out of the equation.

5. *Nivet, Soline. «Des origines du bureau». 2021. Work in progress. Pavillon de l'Arsenal.*

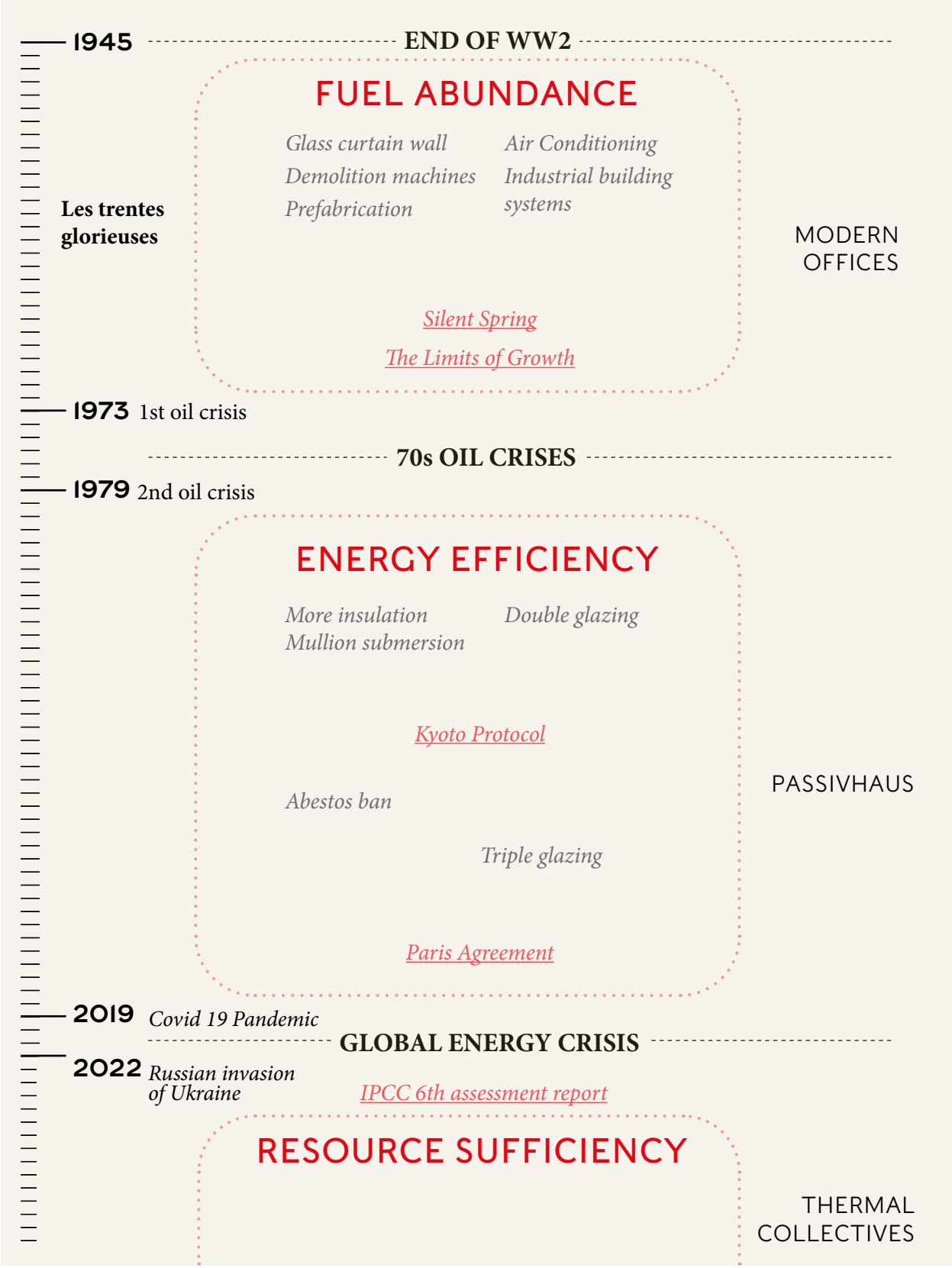

Figure 14. *Abundance, Efficiency and Sufficiency, a quick historiography.*

FROM ABUNDANCE TO SUFFICIENCY

Over the past century, western societies have undergone several shifts in their approach to energy consumption in the built environment. The **abundance of cheap energy** following World War II facilitated the rise of a modern lifestyle characterized by **high levels of resource consumption**. This period of growth and expansion in the built environment was marked by the proliferation of single-family homes and the widespread use of energy-intensive technologies and materials.

This model began to shift in the 1970s due to the **oil crisis** and **rising environmental concerns** (with reports such as "*The limit of growth*" introducing the idea of limited planetary resources). However, since then, most of the efforts have been on preserving growth and high consumption lifestyle while mitigating their impact through more **efficient** technologies (better facade systems, more insulation, culminating today with models like PassivHaus).

However, the **6th IPCC report** shows that over this period, the savings from energy efficiency measures in buildings have been offset by the extra energy consumption they enabled: we consume less energy per square footage, but more square footage per inhabitants. In our current context of global energy crisis and the rising urgency of climate change, we need a more **profound cultural shift** in consumption behaviors that efficiency alone cannot provide.

It is due time to shift to **sufficiency** measures and, with them, new **imaginaries of alternative ways of living**. In this endeavor, we investigate three co-acting and entangled propositions: **Thermal Intelligence**, **Materials Ethics**, and **Collective Living**.

6. *Meadows, Donella H., and Jorgen Randers. Limits to Growth. 1972.*
7. *Chapter 9: Buildings. In IPCC, 2022: Climate Change 2022: Mitigation of Climate Change.*

Figure 15. *A tapestry to shield from cold walls*
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THERMAL INTELLIGENCE

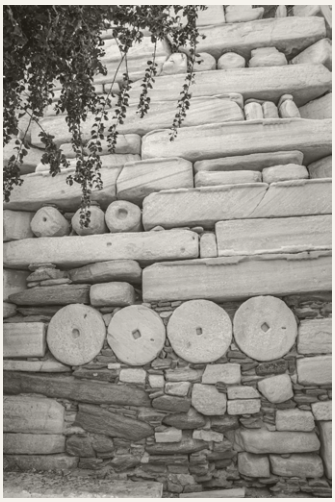
"When thermal comfort is a constant condition, constant in both space and time, it becomes so abstract that it loses its potential to focus [our] attention."

Lisa Heschong[8]

If **thermal intelligence** can be defined as the ability to understand and use thermal properties and phenomena in spaces and objects, then perhaps it can be said that this intelligence have been partly lost in the conquest of modern comfort — which culminates in the abstraction and erasure of thermal properties through uniformization. If we are to look beyond modern comfort, can we reclaim some of this intelligence?

Modern comfort is primarily interested in the conditioning of air. In fact, thermal comfort in building code is solely defined as an air temperature between 19.5°C and 27°C. Still, our sensory experience is influenced by many other factors, such as the **emissivity of materials** (as in radiant heating and cooling) or the ability to **self-regulate our environments** (as in adaptive thermal comfort). The rich worldwide history of **thermal practices** can provide some anchor points in imagining alternative comforts, including more local, **tactical forms of heating** our bodies, more intelligent ways to leverage **materials' thermal properties** and **climatic phenomenons**, and more **collective thermal practices**. In "*Thermal Delight in architecture*," Lisa Heschong surveys these historical precedents and highlights their **cultural and sensorial richness**. Her work indicates that the modern model of uniformization also comes with qualitative losses and that there are numerous sensorial experiences to be reclaimed in alternative forms of comfort.

8. *Heschong, Lisa. "Thermal Delight in Architecture". 1979. MIT Press.*



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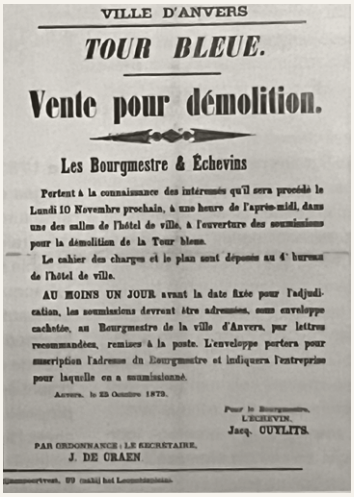

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Figure 27, 28. *Medieval spolias in Paros, Greece and Bodrum, Turkey.*
Figure 29*. *Announcement of a demolition material sale coming up in Anvers in 1879.*

Figure 30*, 31*. *Deconstruction sites in Bruxelles, Belgium circa 1900.*
Figure 32*. *Earthwork machines from WW2*
Figure 33*. *Demolition engine, Bruxelles,1950.*

***** *Images from "Déconstruction et Réemploi"[6].*

MATERIAL ETHICS

Material reuse practices have been ubiquitous in architecture from antiquity until the 19th century[9]. The disappearance of this **care for materials** is tied to the post-war economic and industrial transformations and the subsequent **extreme commodification** of materials that became cheaper alongside energy. The emergence of more efficient destructive demolition machines derived from the military industry and the increasing real-estate pressure were major co-acting forces rendering material reuse unprofitable for the first time in history. This profoundly transformed our societies' **material ethics**.

Today, as a critical opportunity for the building industry to reduce its rampant carbon footprint[10], material reuse is slowly coming back. Beyond technical transformations, it perhaps also involves a more profound **cultural shift** away from our modern material commodification attitude, not unlike **Jane Benett**'s call to re-enchant our relationship with the material world in "*Vibrant matter*"[11].

Applied to domestictiy, this shift calls for a **lower-tech, DIY attitude** which facilitates the **legibility**, **repair**, and **re-arrangement** of material assemblies and gives back to users the opportunity to care for them. In an endeavor to accentuate the inner value of materials, the recognition of their thermal properties also offers the potential to increase this material attention and the desire for circularity even more. With this attitude, heavy demolition rubbles can become precious **thermal mass**, while salvaged sheets of high-conductivity metal or insulating felt panels are opportunities for new **thermal interfaces**. In short, **thermal intelligence** fosters the re-establishment of **material ethics**.

9. *Ghyoot, Michaël et al, pour ROTOR. "Déconstruction et Réemploi". 2022*
10. *De Wolf, Catherine. "Low Carbon Pathways for Structural Design", IASS, 2018*
11. *Bennet, Jane. "Vibrant Matter". 2009*

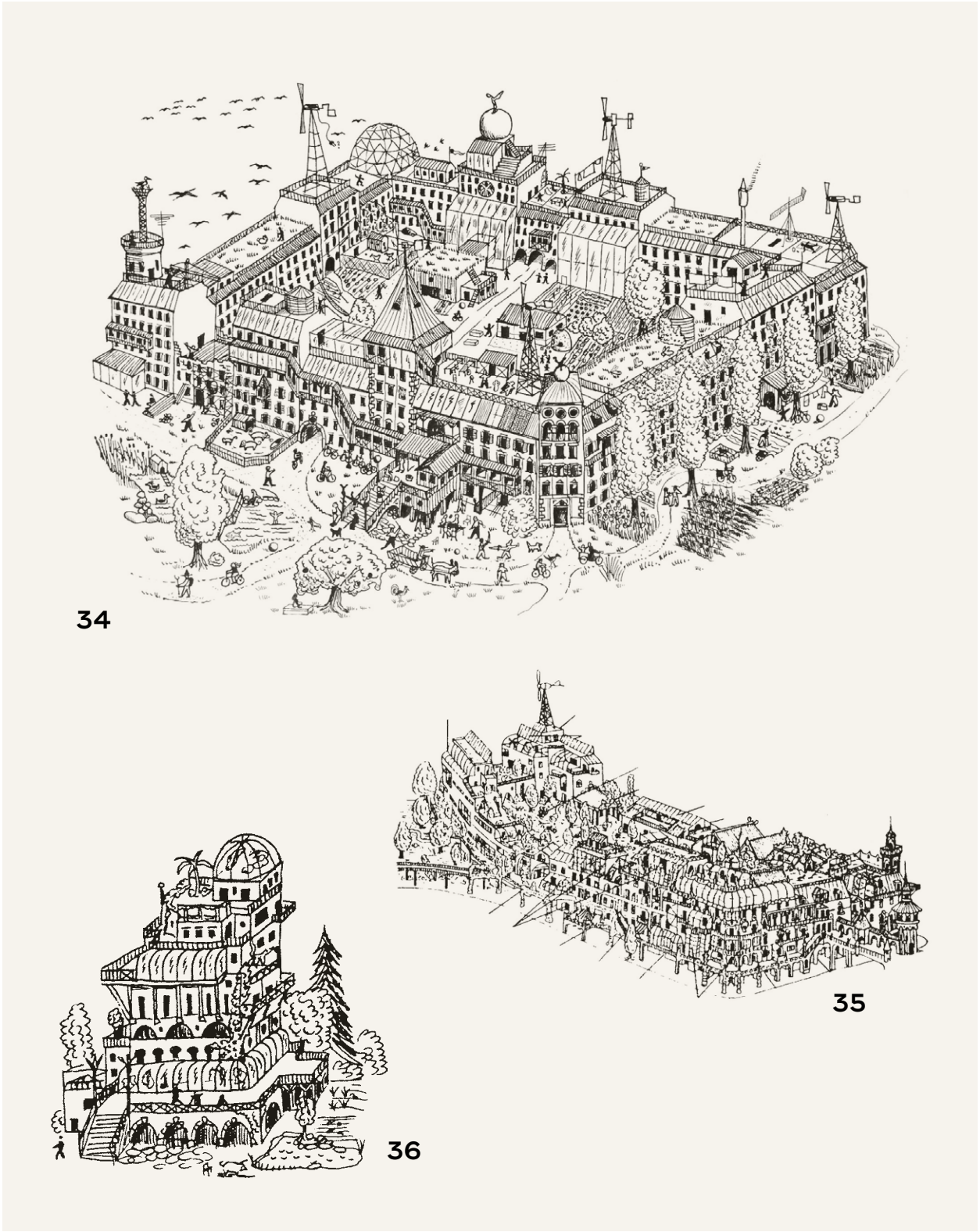


Figure 34-36. *Drawings of Bolo'bolo in Zurich, illustrations from Widmer's essay. The cooperatives imagined by the author are radical retrofit projects merging together several buildings into larger cooperative clusters.*

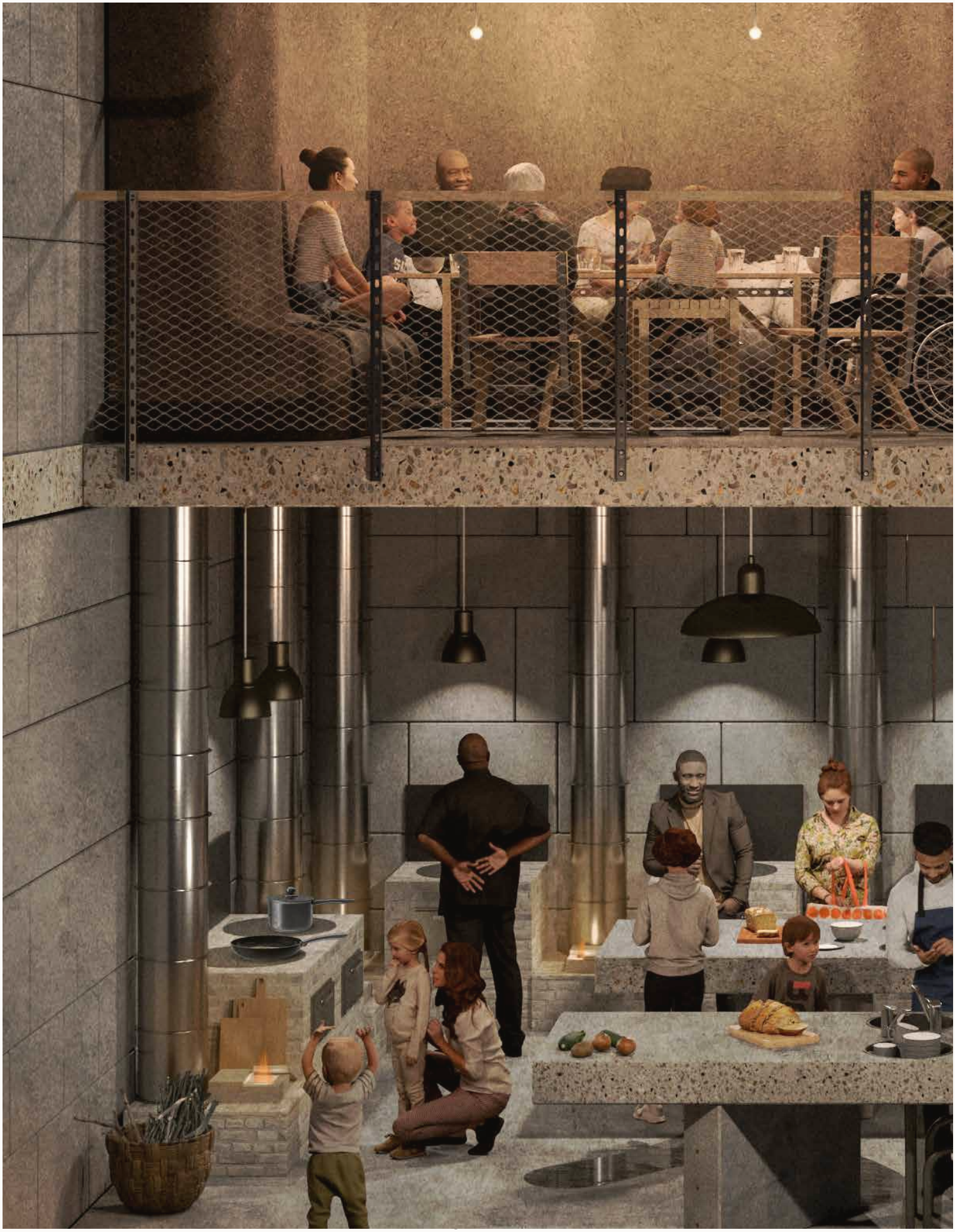
COOPERATIVE LIVING

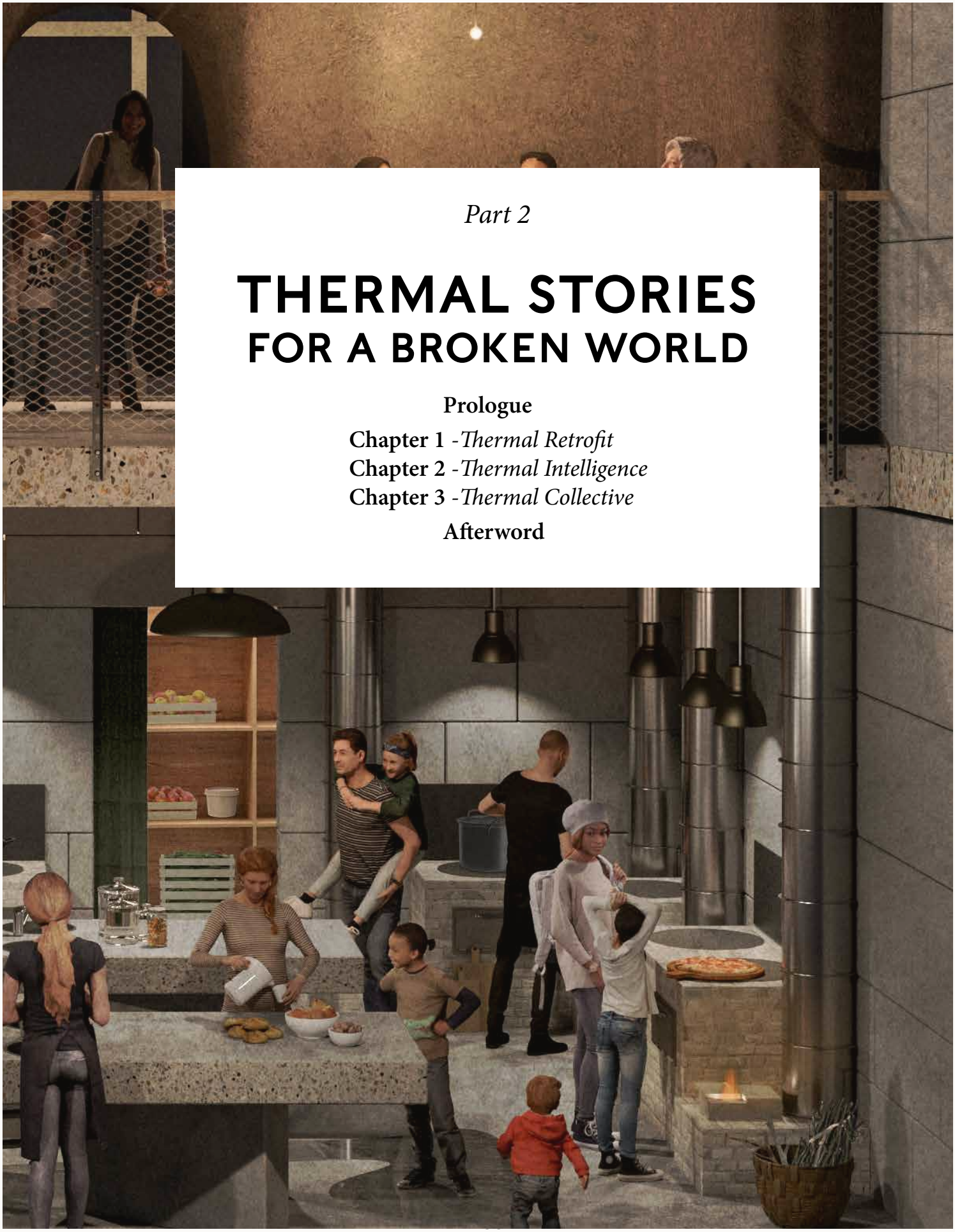
The energy consumption required to achieve domestic comfort directly relates to the **area of dwellings**, which in the last century has never ceased to increase —larger individual private space being one of the expectations of modern comfort. **Reducing** the square footage of dwellings is a straightforward **sufficiency** measure to diminish their environmental impact. Sharing spaces and programs in **collective housing** allow to reduce living units' sizes without losing access to any services and in some cases even proposing programs that could not be available to individual housing. If this shift comes with trade-offs and implies a cultural reconceptions of comfort, it can also generate new qualities and dwelling experiences.

In **cooperative living models**, residents collectively own and manage the property they live in. This model dates back to the 19th century when it was first implemented in Europe to provide affordable housing for working-class individuals. Cooperative housing is often less expensive for residents as they share the costs of maintaining and improving the property. The collective ownership and management of the property promotes a **sense of community and shared responsibility**. Such a supportive living environment is an ideal ground to develop a new mode of dwelling. In his ecologist and anticapitalist essay "*Bolo'Bolo*"[12], **Hans Widmer** radically pushes this idea. He speculates that humanity's salvation from an imminent ecological cataclysm resides in forming small autonomous cooperative communities on a global scale.

Cooperative living has the potential to offer alternatives to privatized uniform comfort based on new shared values such as **thermal intelligence** and **material ethics**. In such collectives, inhabitants could move across a wider variety of spaces and **indoor climates** throughout seasons; they could share **thermal programs** and **material resources**, **hospitality rituals**, and **care and repair practices**.

12. *Widmer, Hans. "Bolo'Bolo". 1983*



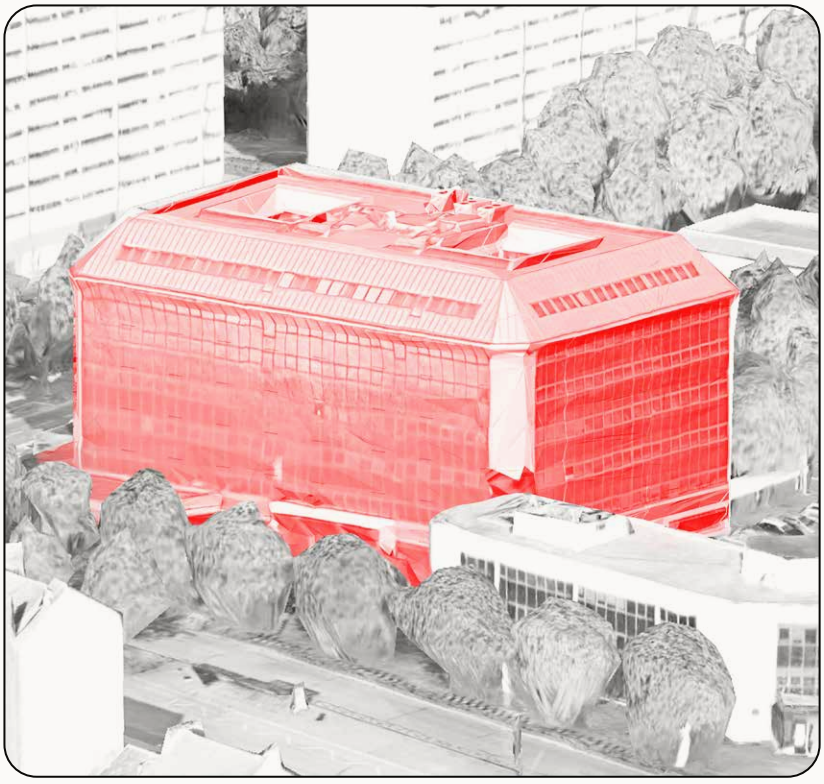


Part 2

THERMAL STORIES
FOR A BROKEN WORLD

PROLOGUE

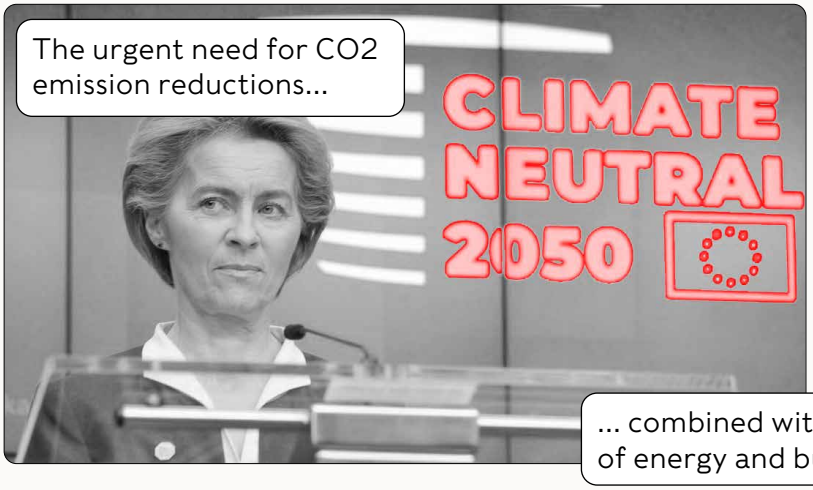
THE COOPERATIVE

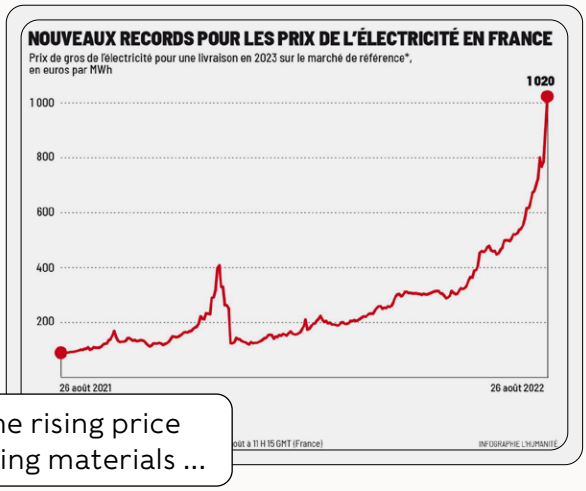


Paris, July 2024

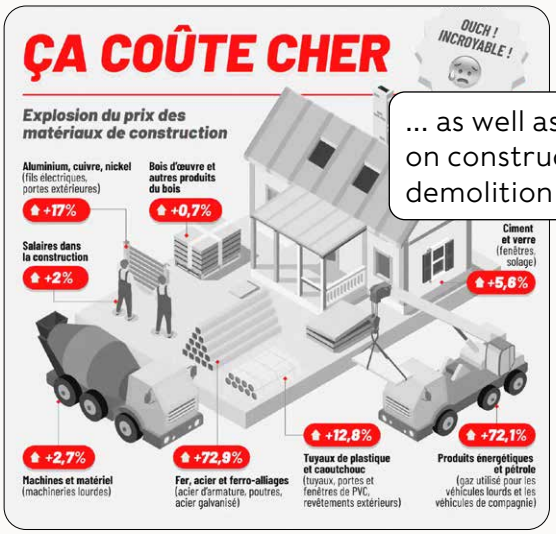
The era of abundance is over.

The urgent need for CO2 emission reductions...





... combined with the rising price of energy and building materials ...



... as well as restrictions on construction and demolition waste ...

... call for alternative modes of building and inhabiting our cities.

In this near-future context of scarcity, a group of people comes together to confront the rising difficulty of maintaining their comfort.

Their vision for living together in an alternative mode of dwelling calls for a new conception of abundance in a world of scarcity, achieved through thermal intelligence.

Their manifesto outlines several fundamentals gathered in three main principles.

THERMAL COLLECTIVE MANIFESTO

Paris, 16th July 2024,

In light of the shrinkage of our comfort induced by the current context of energy scarcity, we are calling for thermal and material intelligence to formulate a new collective way of dwelling. The thermal collective is our proposal alternative to overcome the dying paradigm of modern comfort and retrieve quality in domesticity; it will ask for new knowledges, skills, priorities and forms of expertise. The architectural project that supports our novel collective dwelling endeavor will reify the following fundamentals:

1. LIVING WITH THERMAL PROPERTIES AND CLIMATE

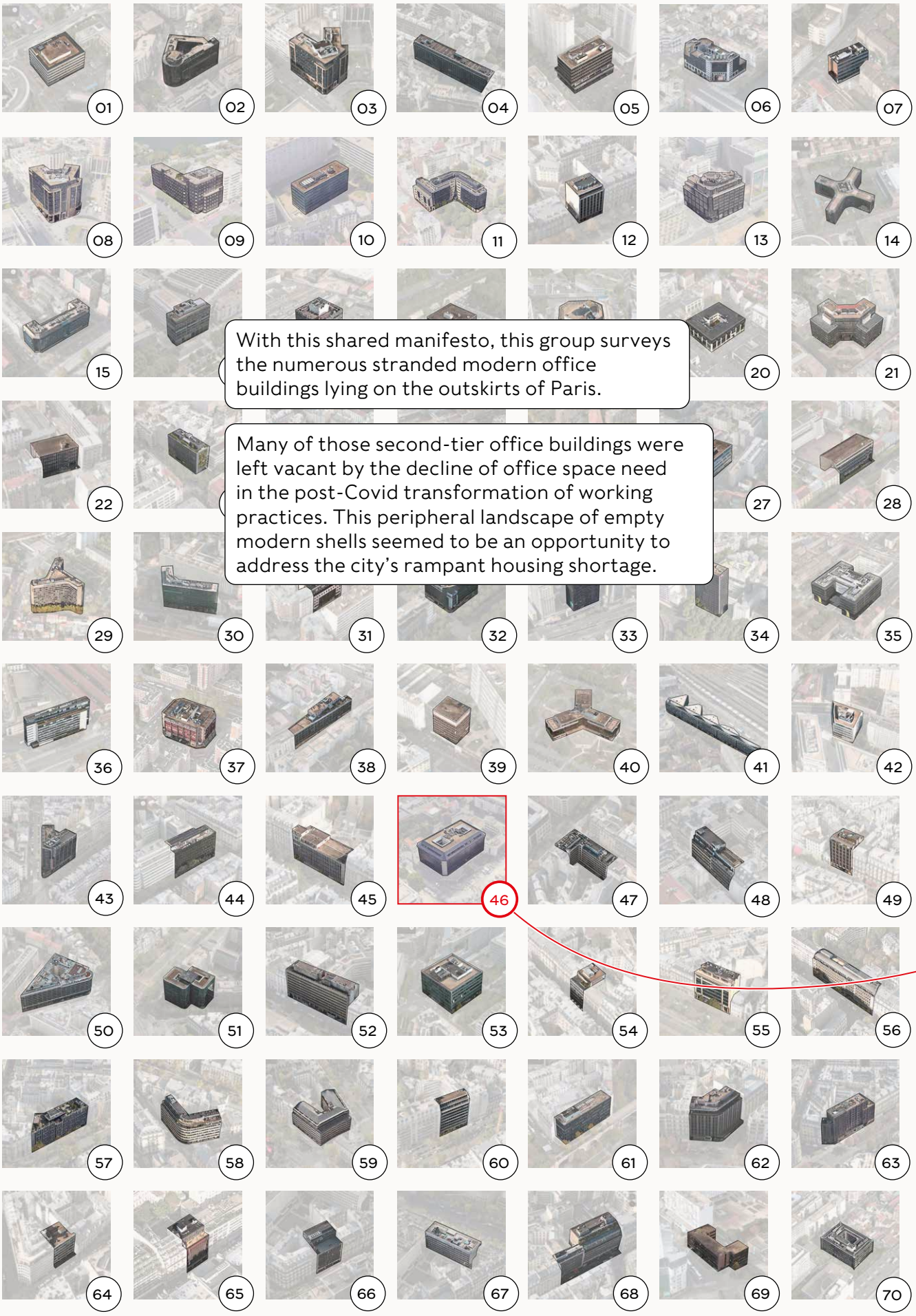
We need to dwell in tune with thermal properties and climatic variations. This means harnessing the naturally occurring vertical air-flows, leveraging materials' thermal conductivity and heat capacity, and embracing seasonality and temporal use. All these principles will allow us to reduce reliance on fuel-based active conditioning

2. COLLECTIVIZING LIVING SPACE

We need to collectivize living spaces. This means minimizing individual private spaces in favor of shared programs and amenities. It will enable access to a larger variety of spaces, programs and indoor climates and offer a viable alternative to private uniform comfort.

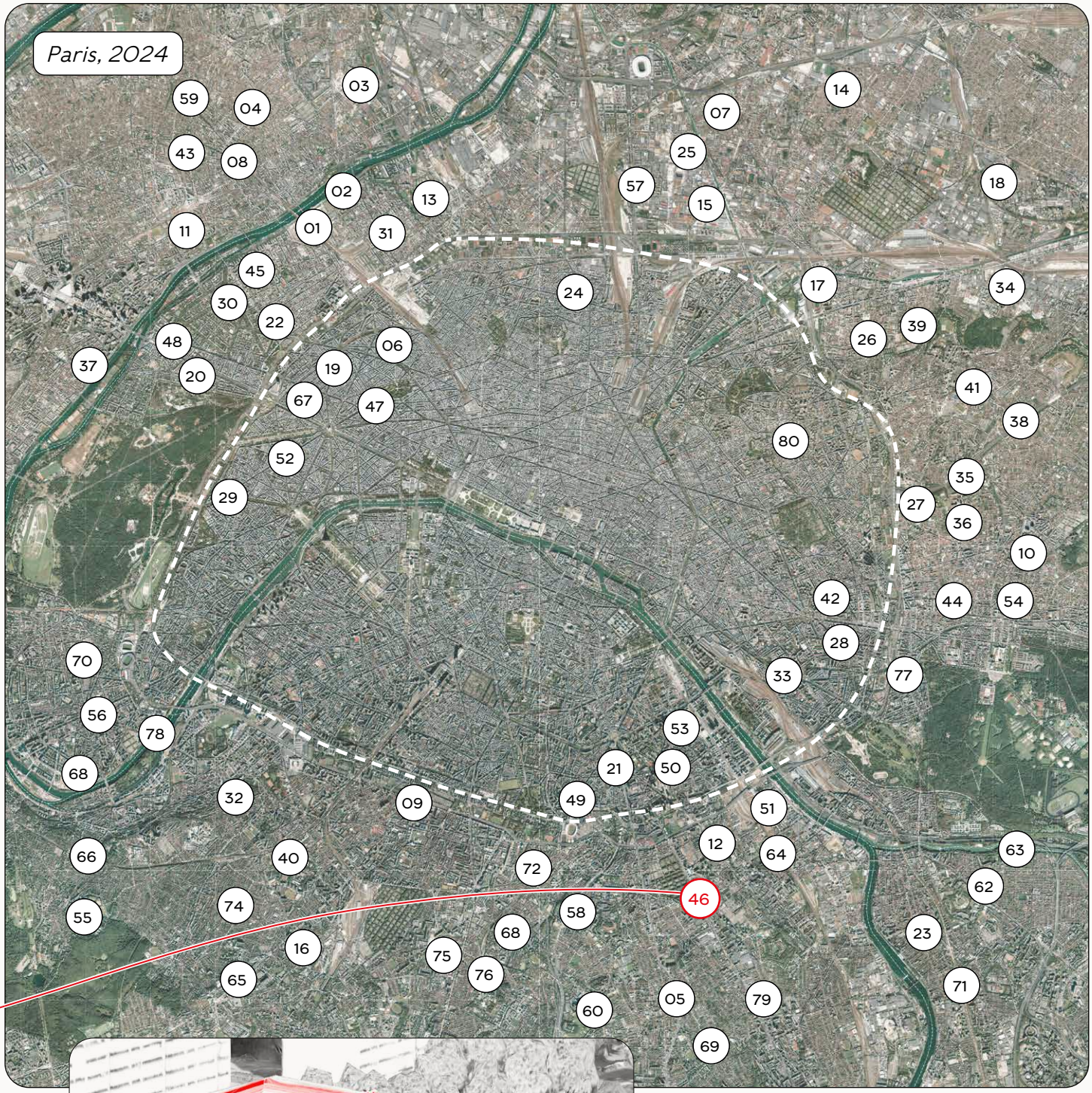
3. APPLIYING THERMAL INTELLIGENCE TO MATERIAL ETHIC

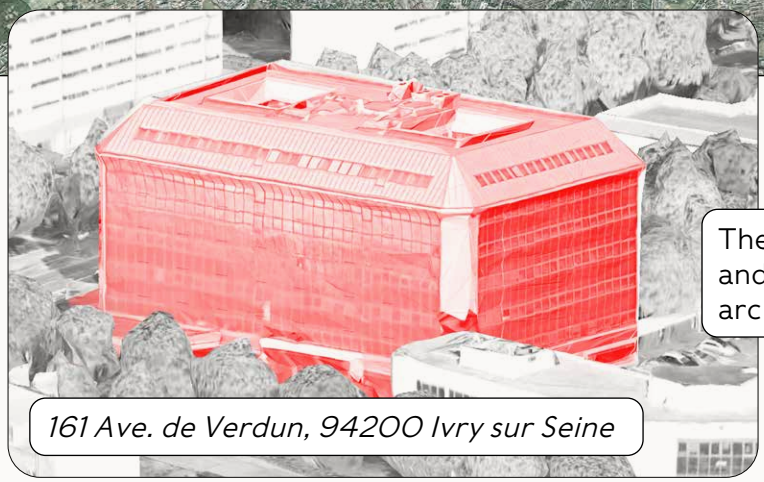
We need to rethink construction and maintenance. This starts on the construction site, with the reuse of an existing building and the re-arrangement of the existing material. It will extend in a DIY low-tech attitude to the fabrication and maintenance of the interior fit-outs designed around legibility and hackability. This material ethic stems excessive material extraction and waste.



With this shared manifesto, this group surveys the numerous stranded modern office buildings lying on the outskirts of Paris.

Many of those second-tier office buildings were left vacant by the decline of office space need in the post-Covid transformation of working practices. This peripheral landscape of empty modern shells seemed to be an opportunity to address the city's rampant housing shortage.



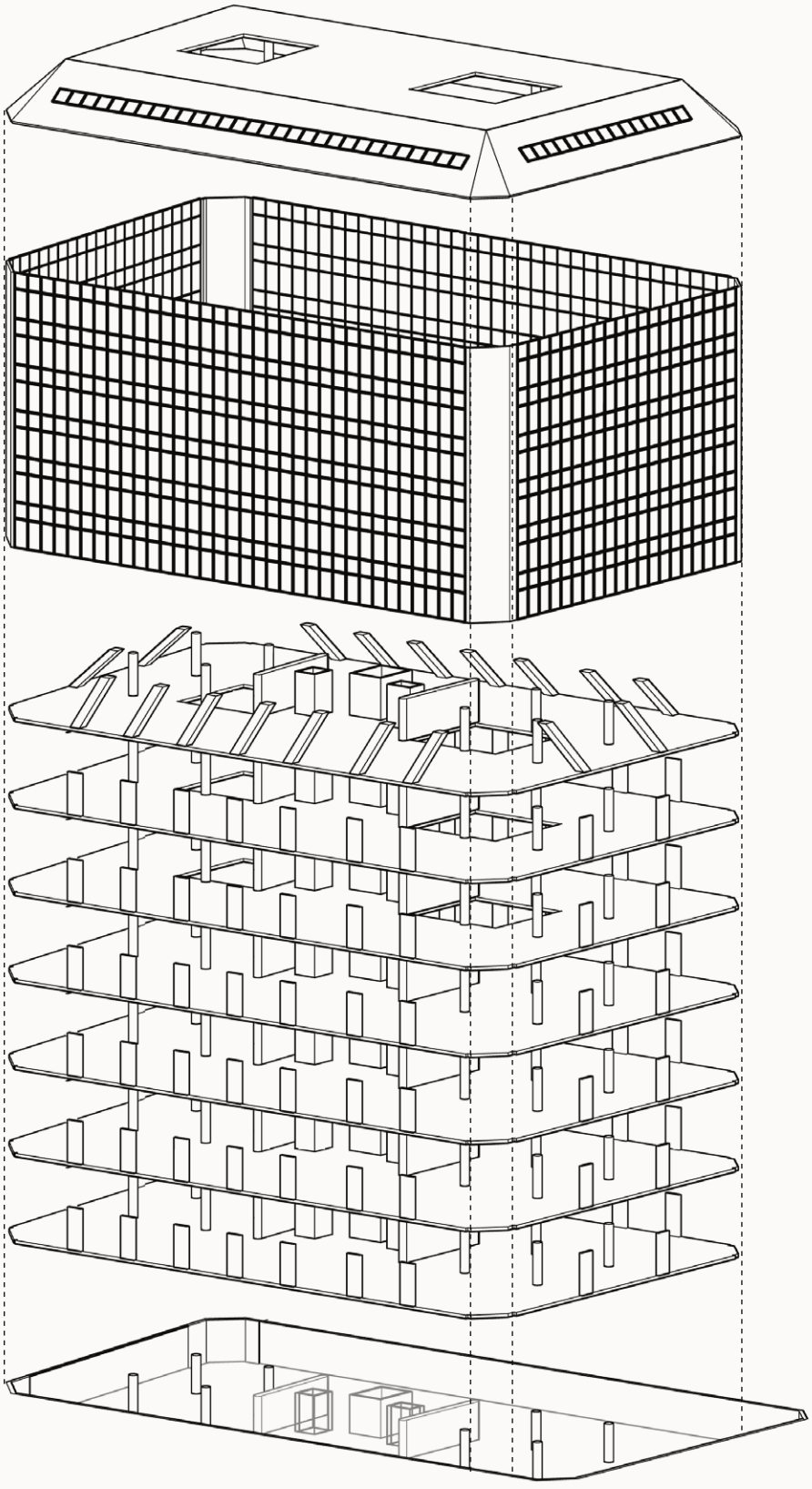


161 Ave. de Verdun, 94200 Ivry sur Seine

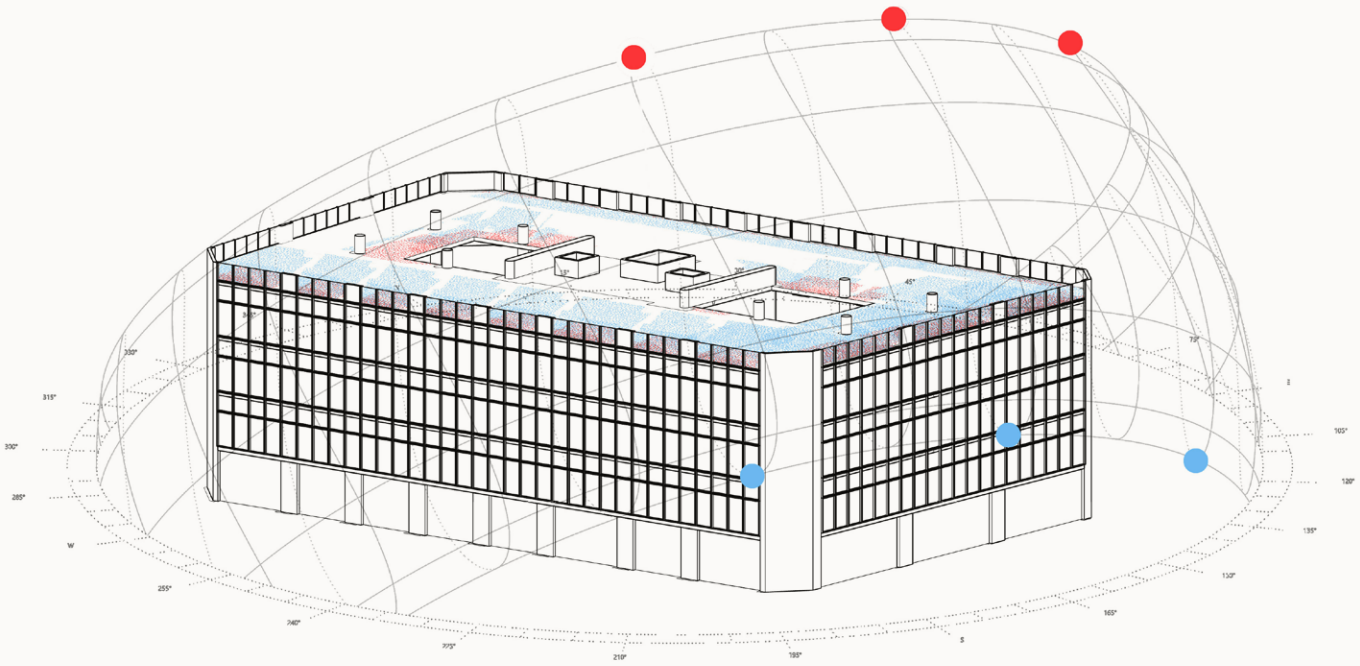
They acquire one of them at a bargain, and commission an experienced thermal architect to counsel them.

The architect's « reading » of the existing office building reveals a complete asymmetry between:

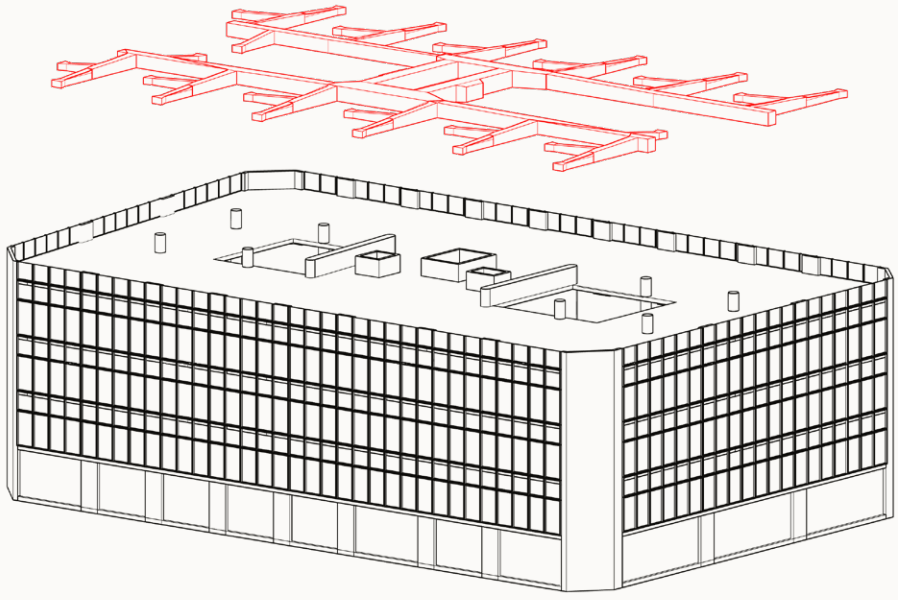
the material arrangements of the building (an array of horizontal concrete slabs blocking air circulation and wrapped in a glass curtain wall) ...



... the climatic reality of the site (a very specific south-west orientation) ...



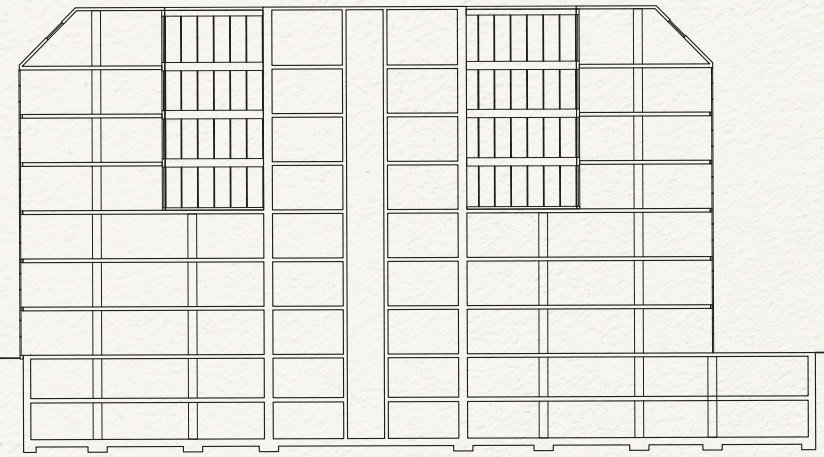
... and its thermal strategy (a fuel-intensive conditioning system pumping air in each office space to erase temperature difference at all corners of the building).

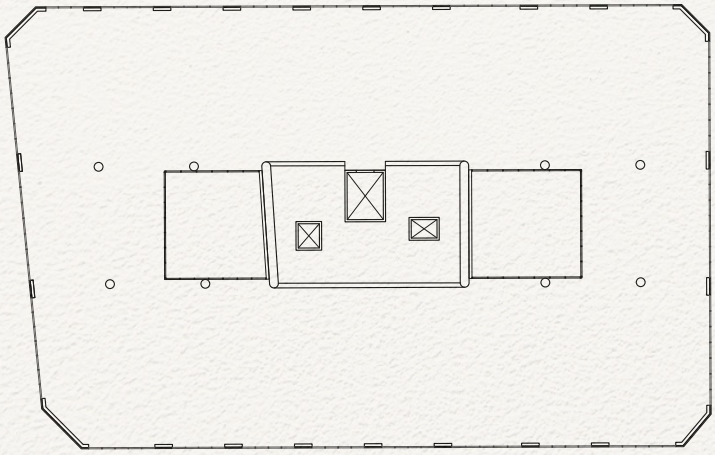


Given these conditions, the architect designs the major spatial and infrastructural rearrangements to unlock the passive thermal capacity of the building.

ESQ_001
EXISTING PLANS

PARIS
16 JUILLET 2024





MAÎTRE D'ŒUVRE

Co-opérative "Collectif thermique"
161 Ave. de Verdun
94200 Ivry sur Seine

LÉGENDE

- Existant
- Démolition
- Extension

MAÎTRE D'OUVRAGE

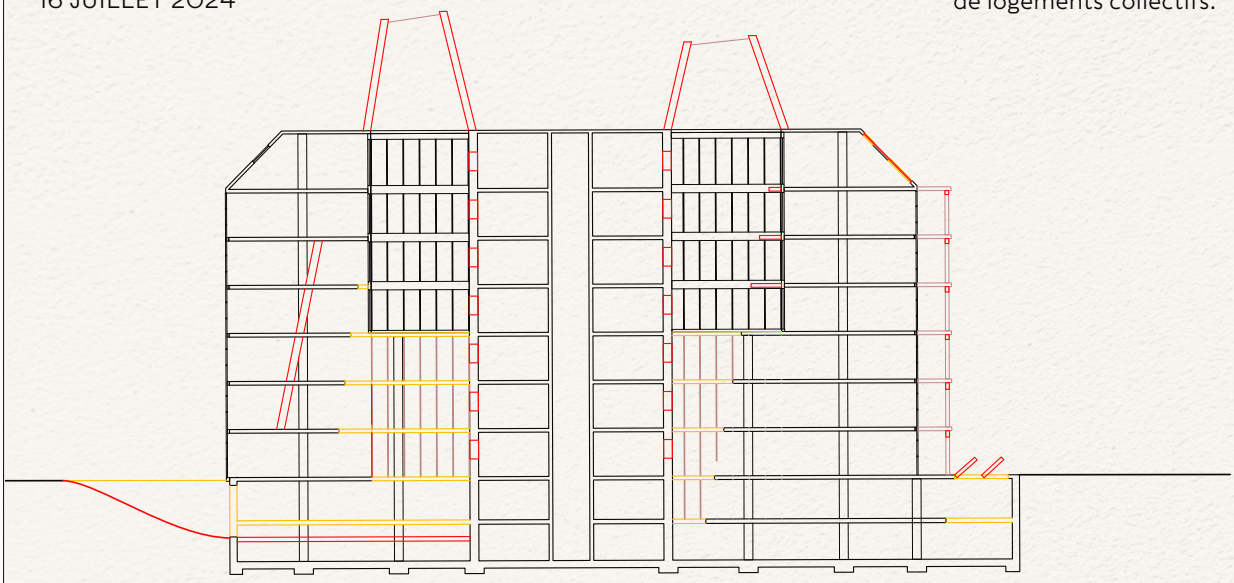
HEATSCAPES
Ré-aménagement thermique
23 Rue Renaudes
75012 Paris

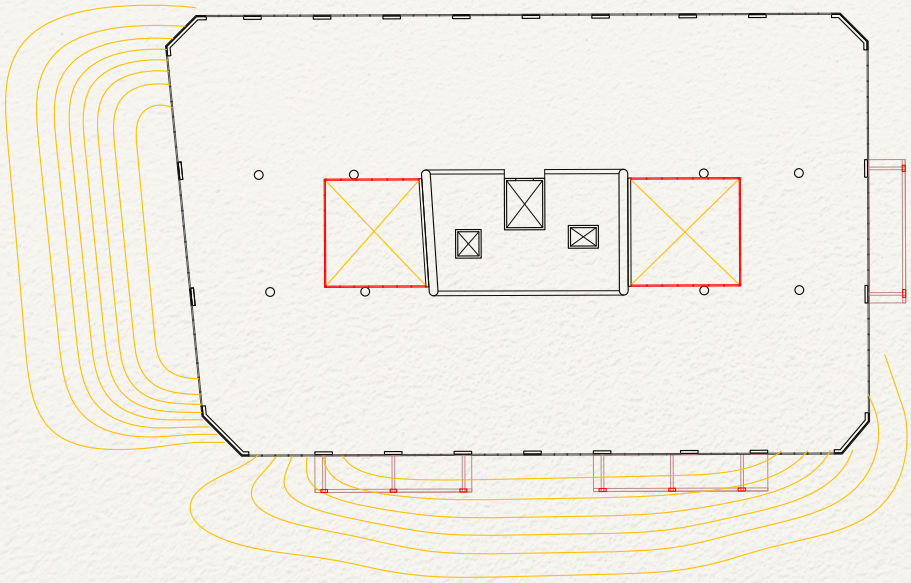
ESQ_002
RE-ARRANGEMENT PLANS

PARIS
16 JUILLET 2024

PHASE D'ETUDE

Réarrangement thermique d'un bâtiment de bureau moderne pour co-opérative de logements collectifs.





MAÎTRE D'ŒUVRE

Co-opérative "Collectif thermique"
161 Ave. de Verdun
94200 Ivry sur Seine.

LÉGENDE

- Existant
- Démolition
- Extension

We will follow the stories of some of the inhabitants as they construct, live in and care for their Thermal Collective.

CHAPTER 1

THERMAL RETROFIT

This story recounts the maintenance of the thermal collective and its material cycles of construction and interrogates what is material comfort without abundance.

Chiara - 36 years old

Paris, July 2029


I work cutting concrete slabs in the old office buildings south of Paris.

Today, as I was riding the tram home, I recalled the time when I was working on the construction site that became the co-op where I now live.

That was my first job as a concrete sawyer. It felt a bit messy and overwhelming at the time.

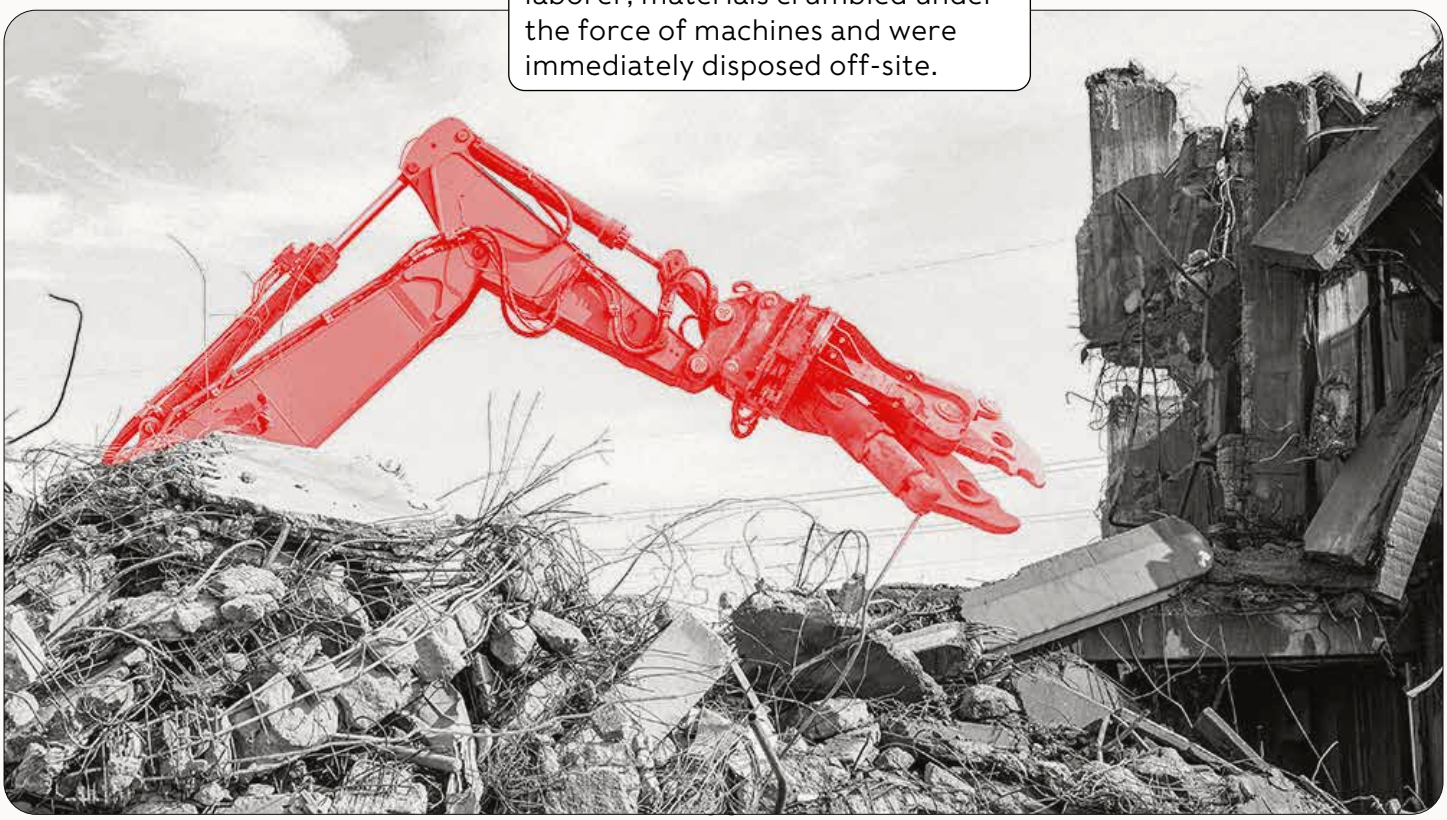
We started by partially disassembling the curtain wall facade.

Then we made a few excavations in front of the building while some roofing was removed.

But mostly, we cut a LOT of concrete to create new entrances and allow light and air to reach the lower levels of the building through the courtyards.

It was only after completing the job that I realized how essential these material re-arrangements had been in transforming the deep office floor plates into spaces for living.

In my previous job as a demolition laborer, materials crumbled under the force of machines and were immediately disposed off-site.

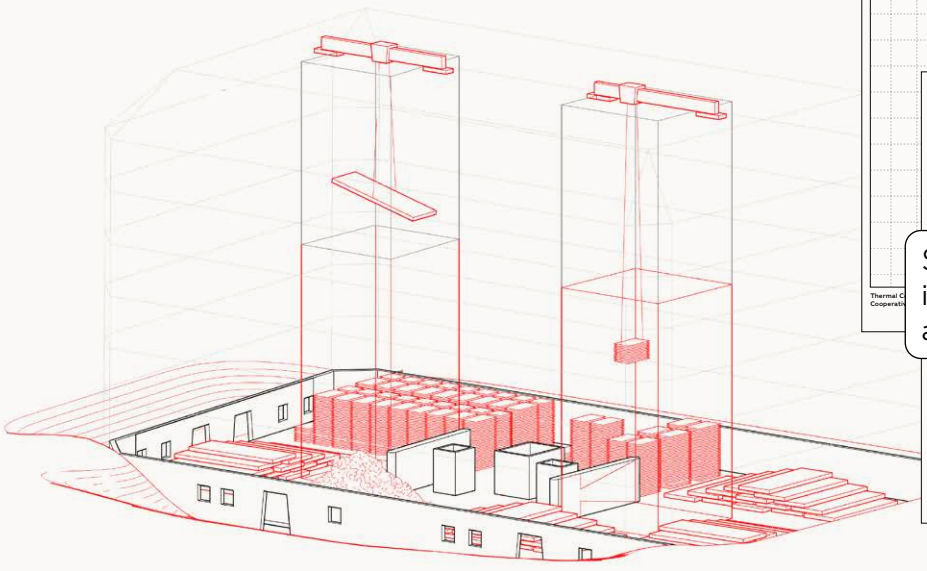


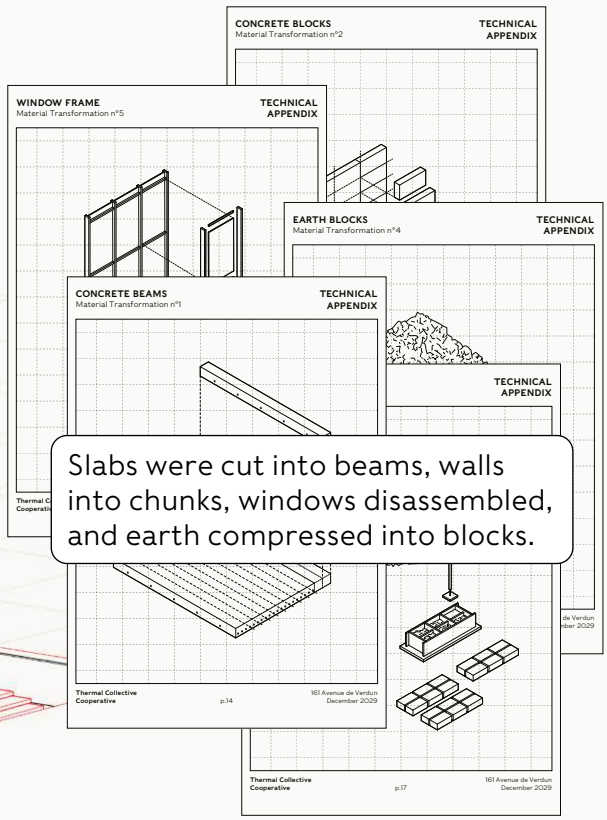
But with the new C&D waste laws, it seemed in the co-op's best interest to keep and reuse everything...

...even the former office fit-outs, which, at the time, looked worthless to everyone in our team.

All materials, however, were carefully disassembled and stored in the former parking levels.

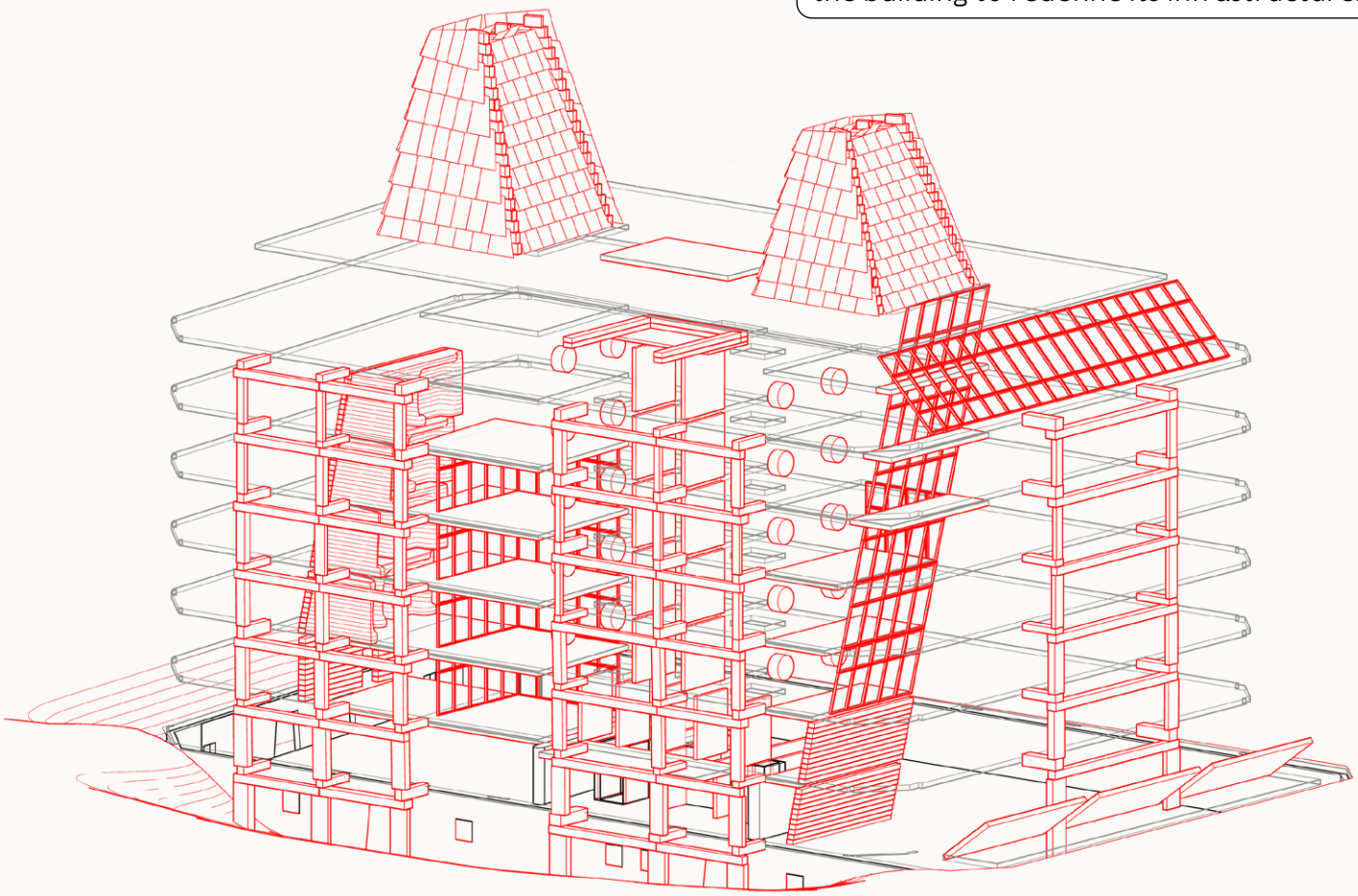
Down there, they were transformed.





Slabs were cut into beams, walls into chunks, windows disassembled, and earth compressed into blocks.

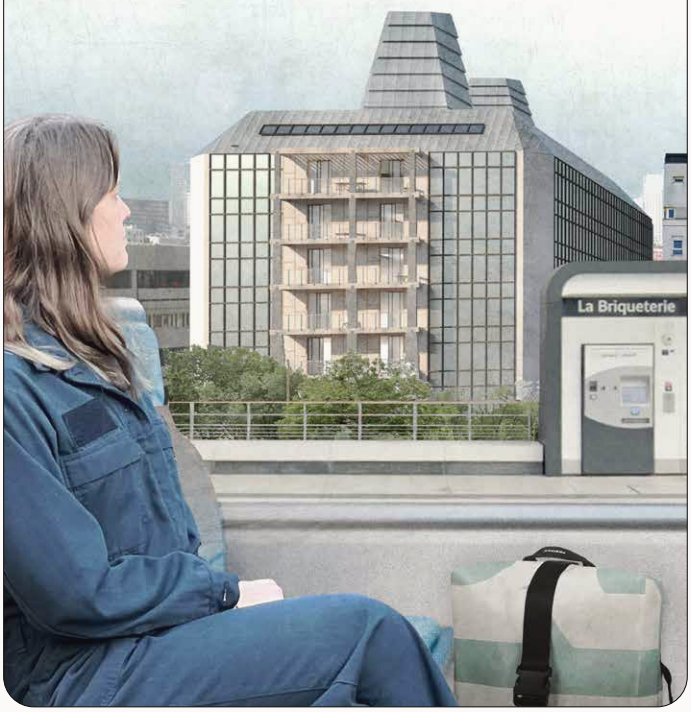
Eventually, materials were lifted up through the courtyards and re-deployed throughout the building to redefine its infrastructure.




...put together by stacking re-arranged concrete chunks against the facade, they provide bedrooms with a thermal buffer in the winter and shade in the summer.

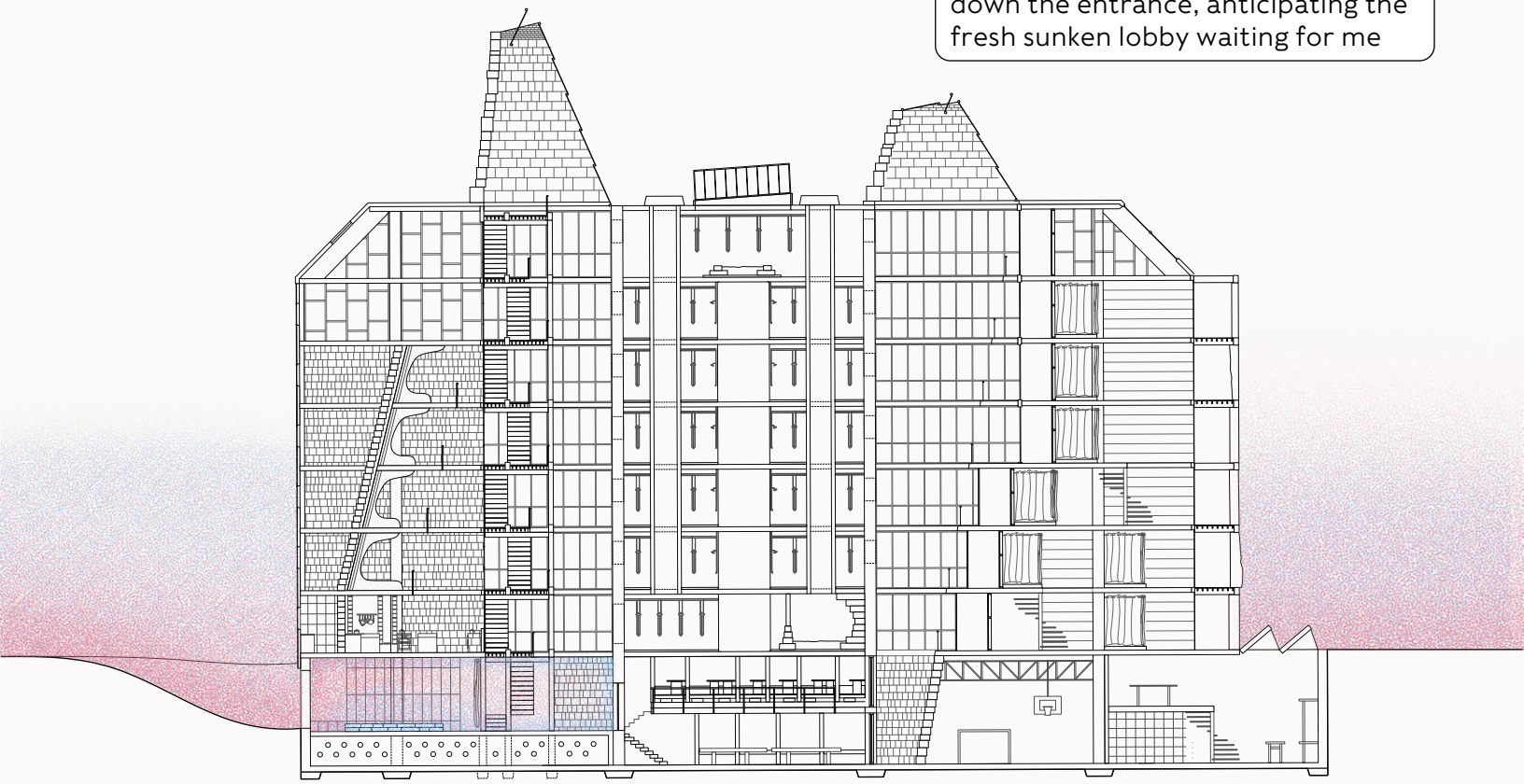
The tram came to a halt with a long squeak.

It was my stop.



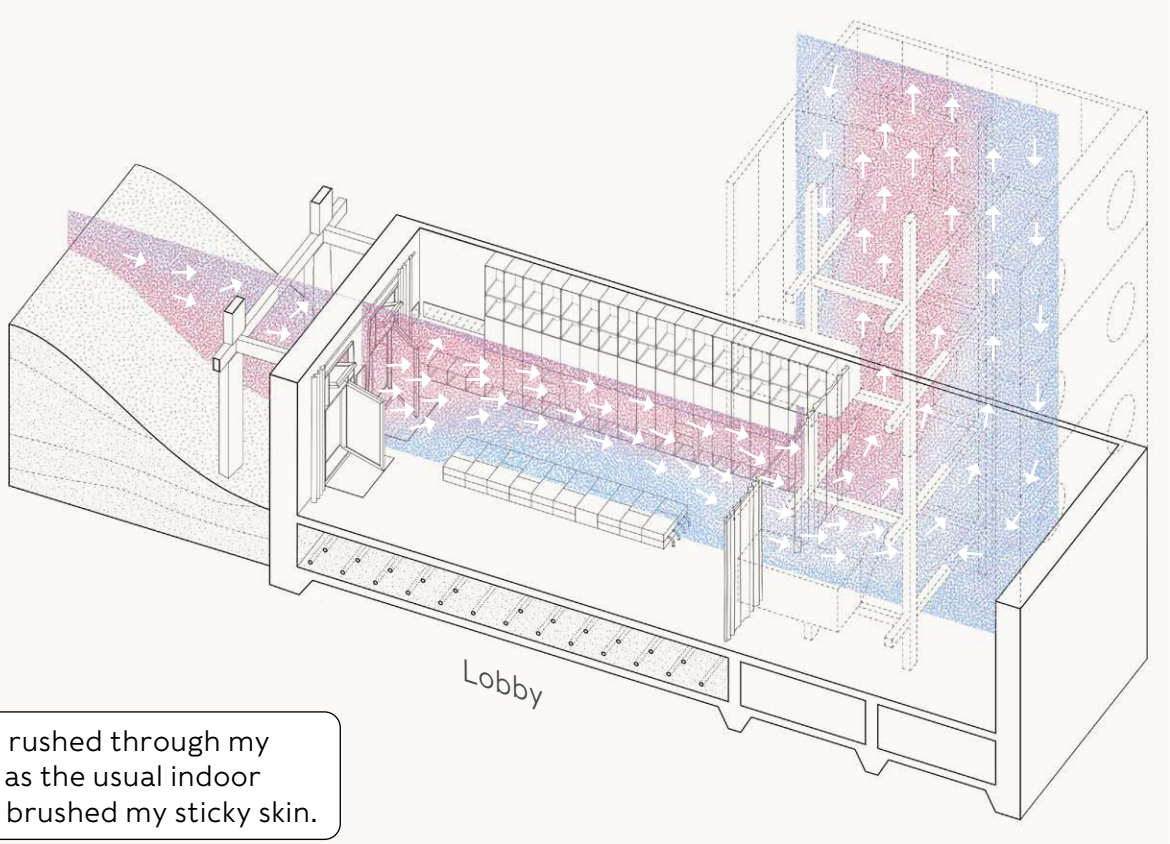
Under the blazing sun, the short walk from the station to the co-op felt like a never-ending desert.

I sighed in relief when I finally walked down the entrance, anticipating the fresh sunken lobby waiting for me



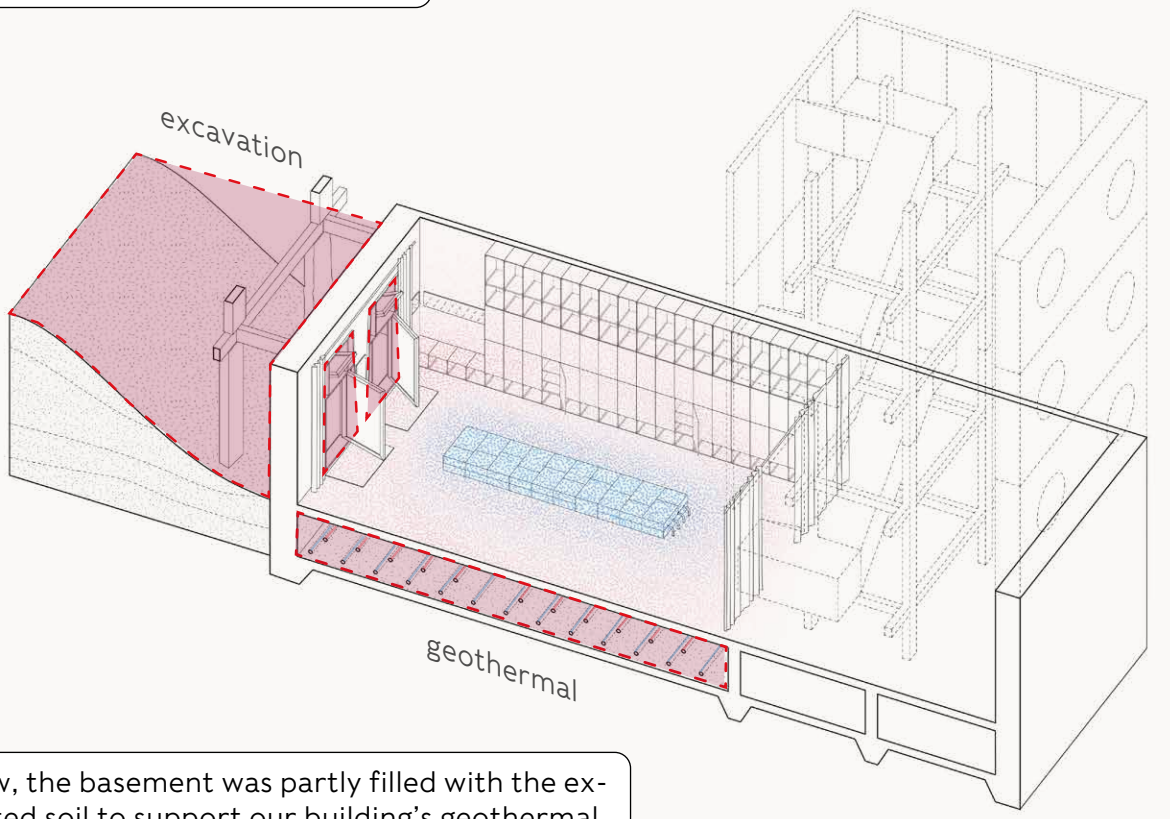
I collapsed on the bench, took off my working boots and construction jacket, and laid back against the cold concrete.

The space was always a bit crowded, but it made a good thermal buffer.



Chills rushed through my body as the usual indoor draft brushed my sticky skin.

I stayed for a while, remembering when we saw out and excavated the entrance opening.

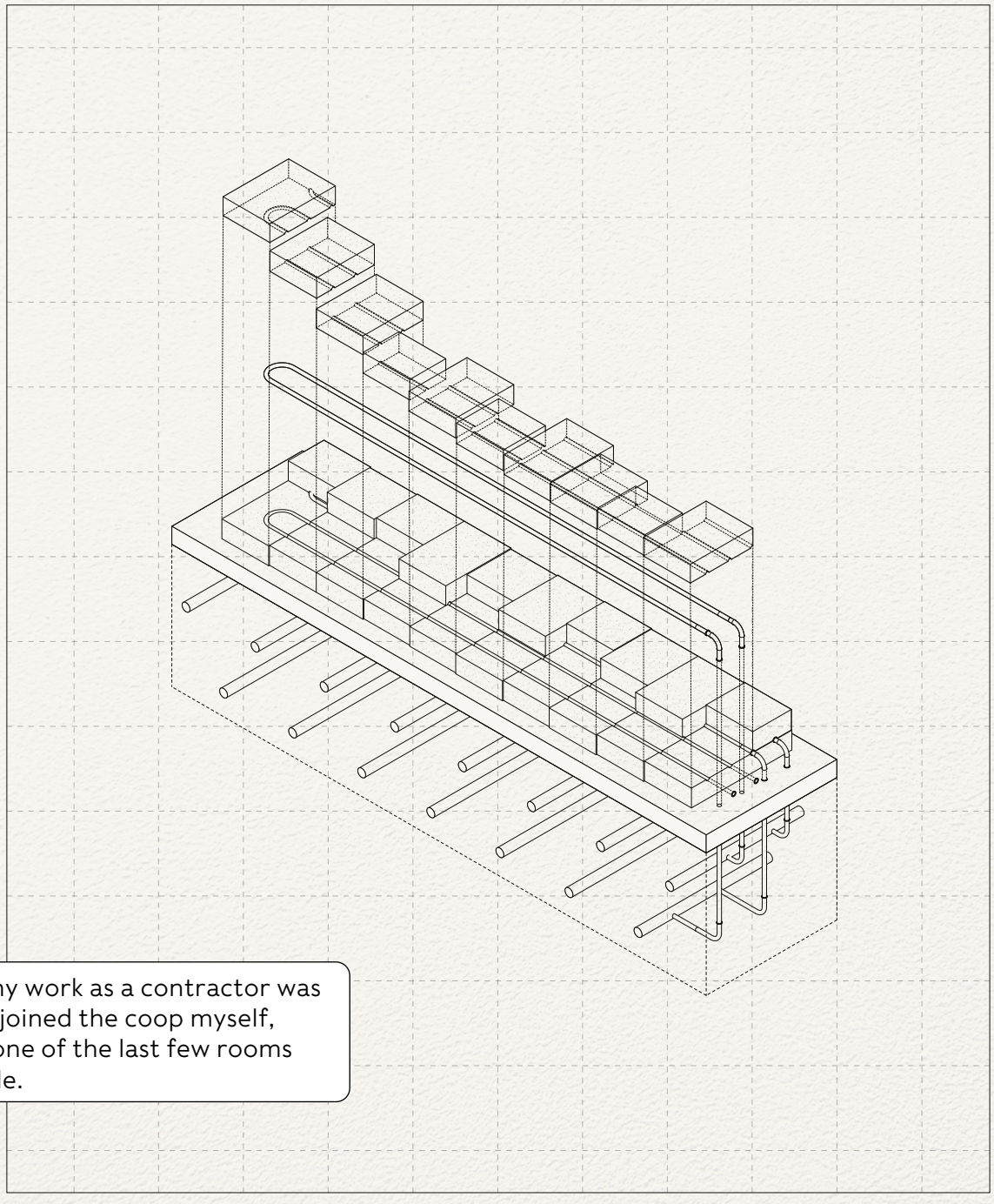


Below, the basement was partly filled with the excavated soil to support our building's geothermal water heat-exchanger.

RADIANT BENCH

Thermal Device n°2

The entrance's concrete offcuts were used to create a radiative bench. With running geothermal water to keep it cool in summer and warm in winter, it stands as the central thermal piece of this transition space.



After my work as a contractor was done, I joined the coop myself, taking one of the last few rooms available.

Thermal Collective Cooperative

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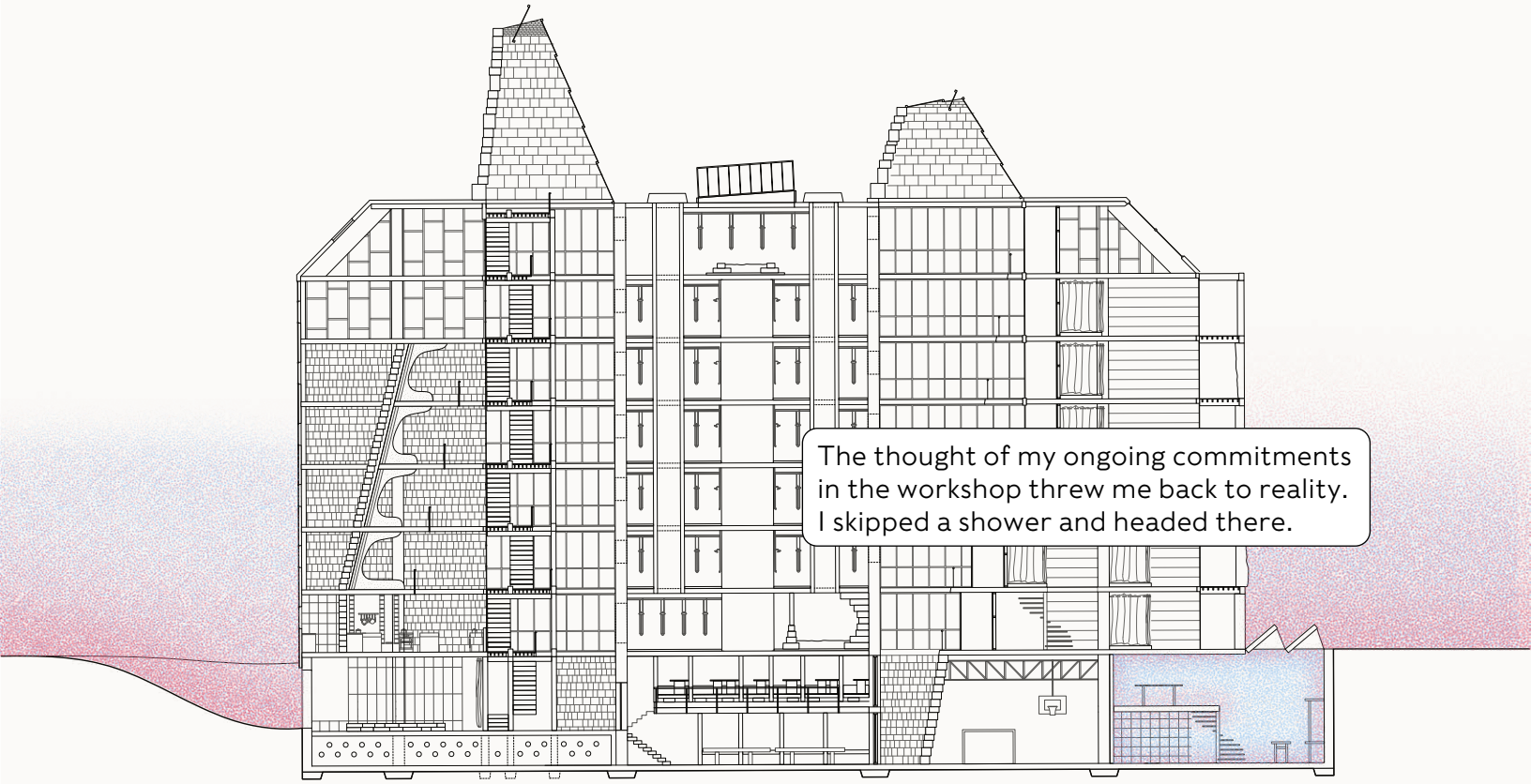
December 2029

As was the custom, I continued being involved in the construction work, but this time as a co-op member responsible for the house's fit-outs.

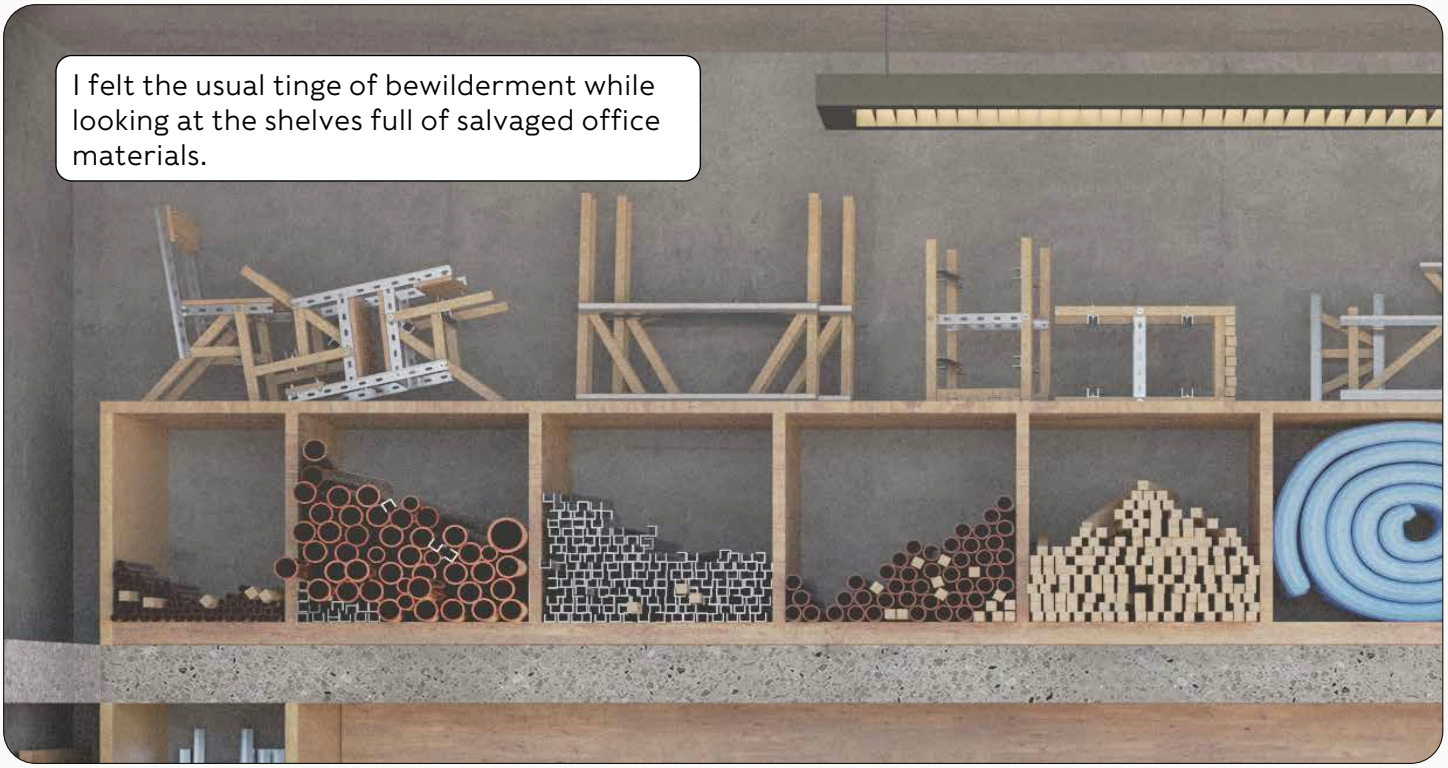
Developing the skills and agency to maintain the space in which I live is empowering...

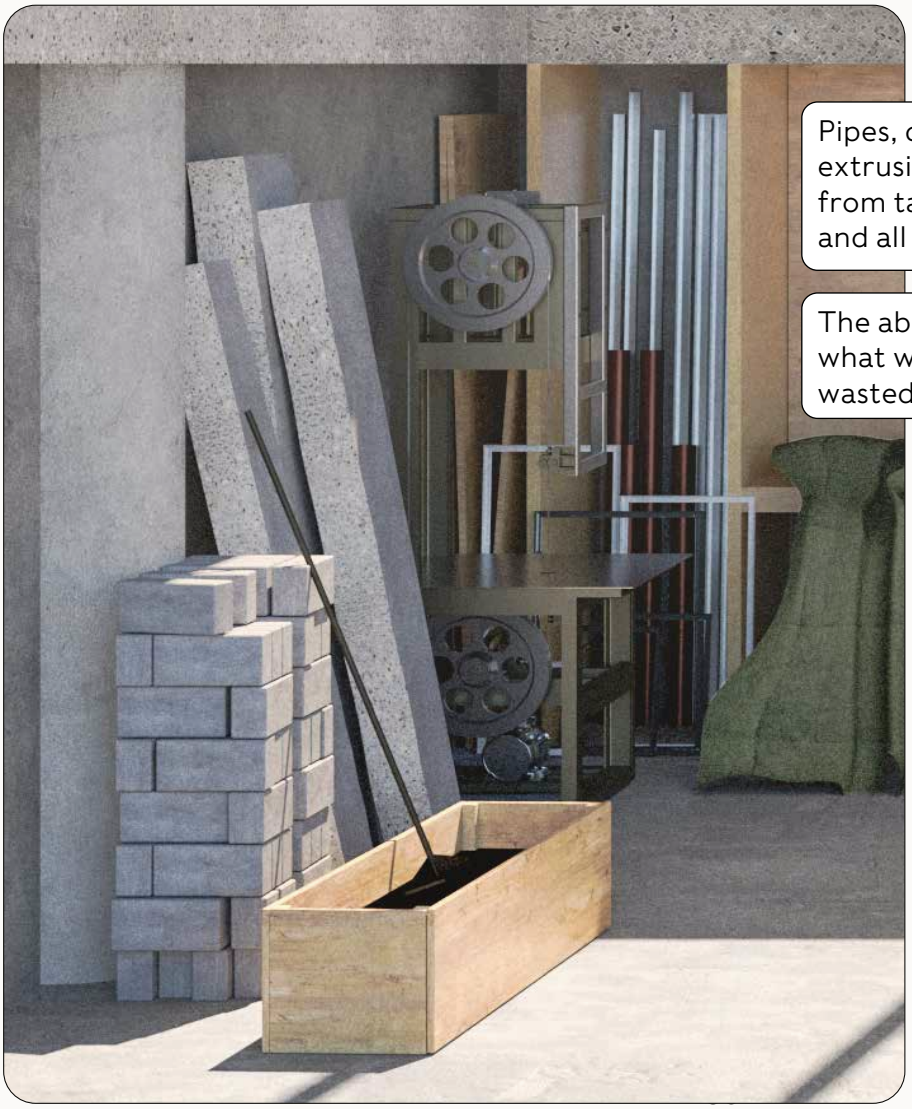
—in essence, we are in full control—

...although, somedays it feels like things break faster than we can repair them, and that this building collective will forever remain an unfinished project.



The thought of my ongoing commitments in the workshop threw me back to reality. I skipped a shower and headed there.





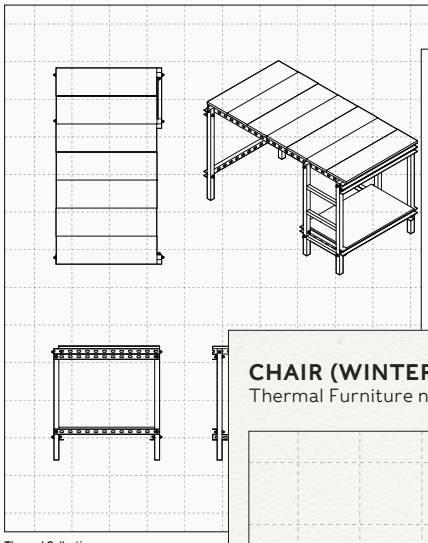
Pipes, carpet tiles, aluminum extrusions, boards disassembled from tabletops, doors, frames, and all kinds of wooden studs...

The abundance provided by what would have otherwise been wasted never failed to amaze me.


A few people were there...
Jacek waved at me from behind a mountain of wooden scraps and aluminum extrusions.

DESK
Thermal Furniture n°3

TECHNICAL APPENDIX



Thermal Collective Cooperative

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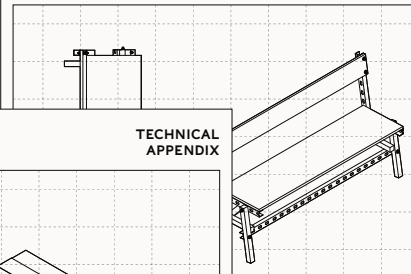
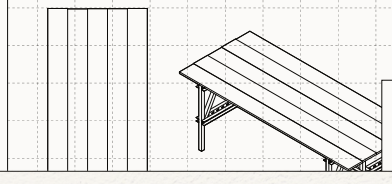
BENCH
Thermal Furniture n°3

TECHNICAL APPENDIX



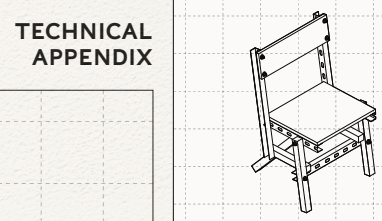
DINING TABLE
Thermal Furniture n°3

TECHNICAL APPENDIX



CHAIR (SUMMER)
Thermal Furniture n°3

TECHNICAL APPENDIX



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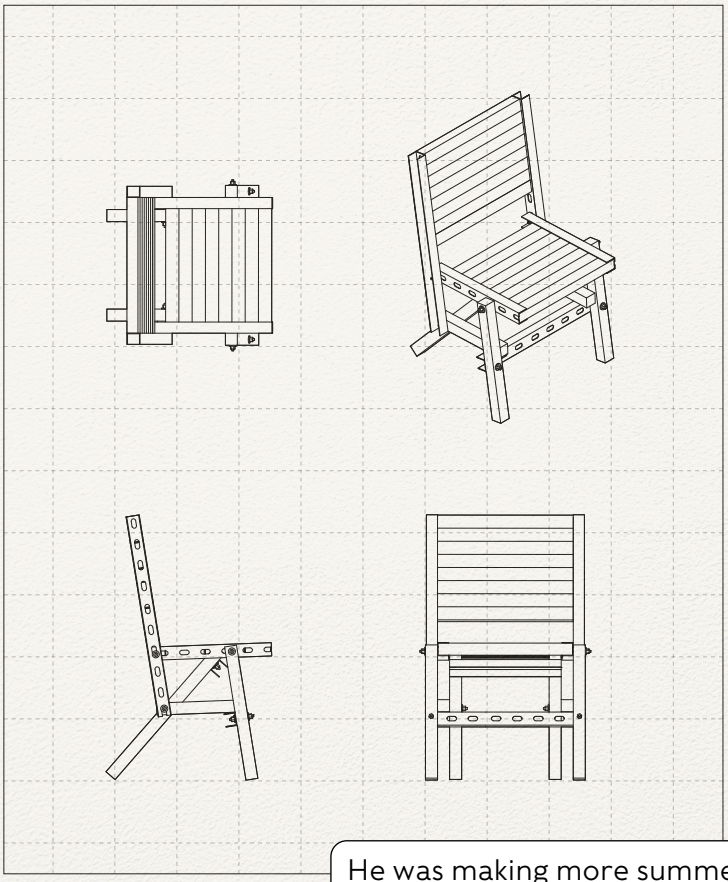
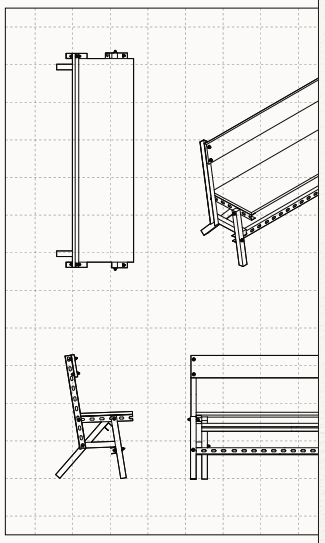
CHAIR (WINTER)
Thermal Furniture n°3

TECHNICAL APPENDIX



Thermal Collective Cooperative

BENCH
Thermal Furniture n°3



Thermal Collective Cooperative

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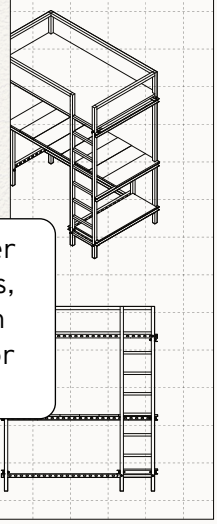
TECHNICAL APPENDIX



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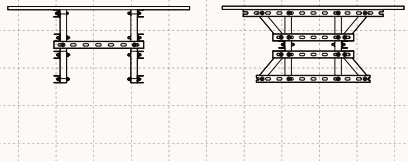

Thermal Collective Cooperative

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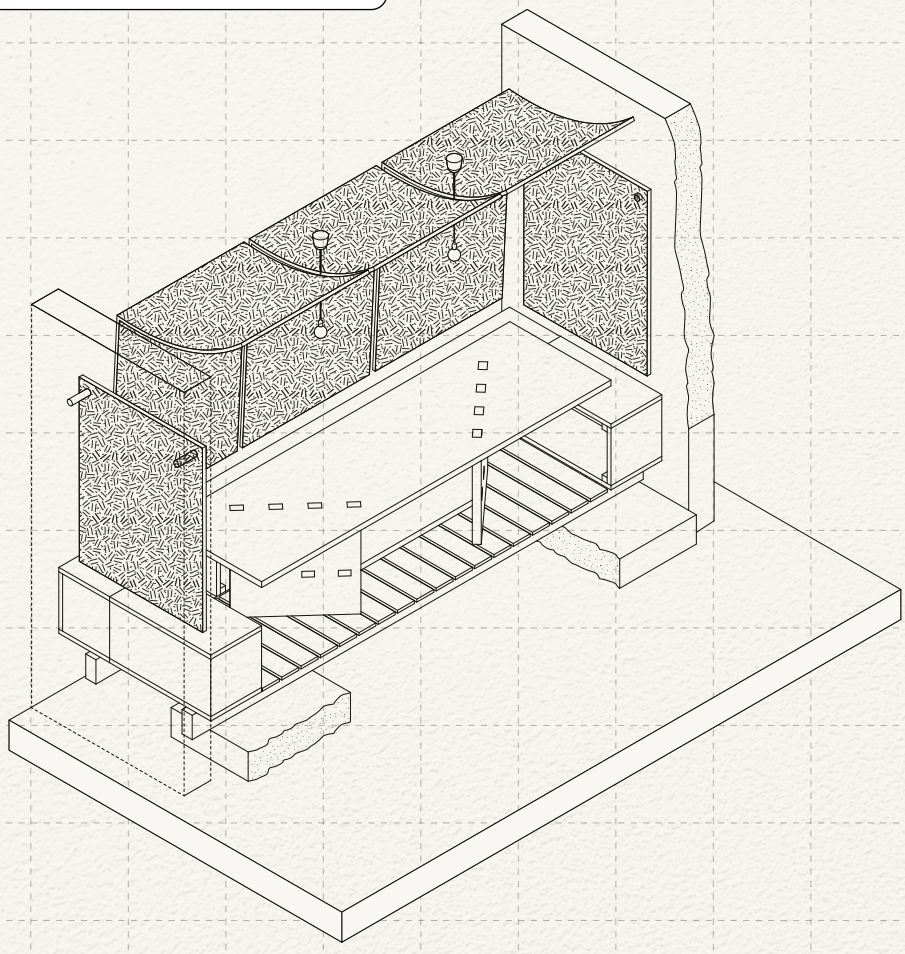
He was making more summer chairs for the common areas, using aluminum profiles with high thermal conductivity for the seat and back rest.

FELT NOOK
Thermal Device n°4

TECHNICAL APPENDIX

Part of my coop work this season was to expand the winter tapestries for the library using felt panels from the old office partitions.



Thermal Collective Cooperative

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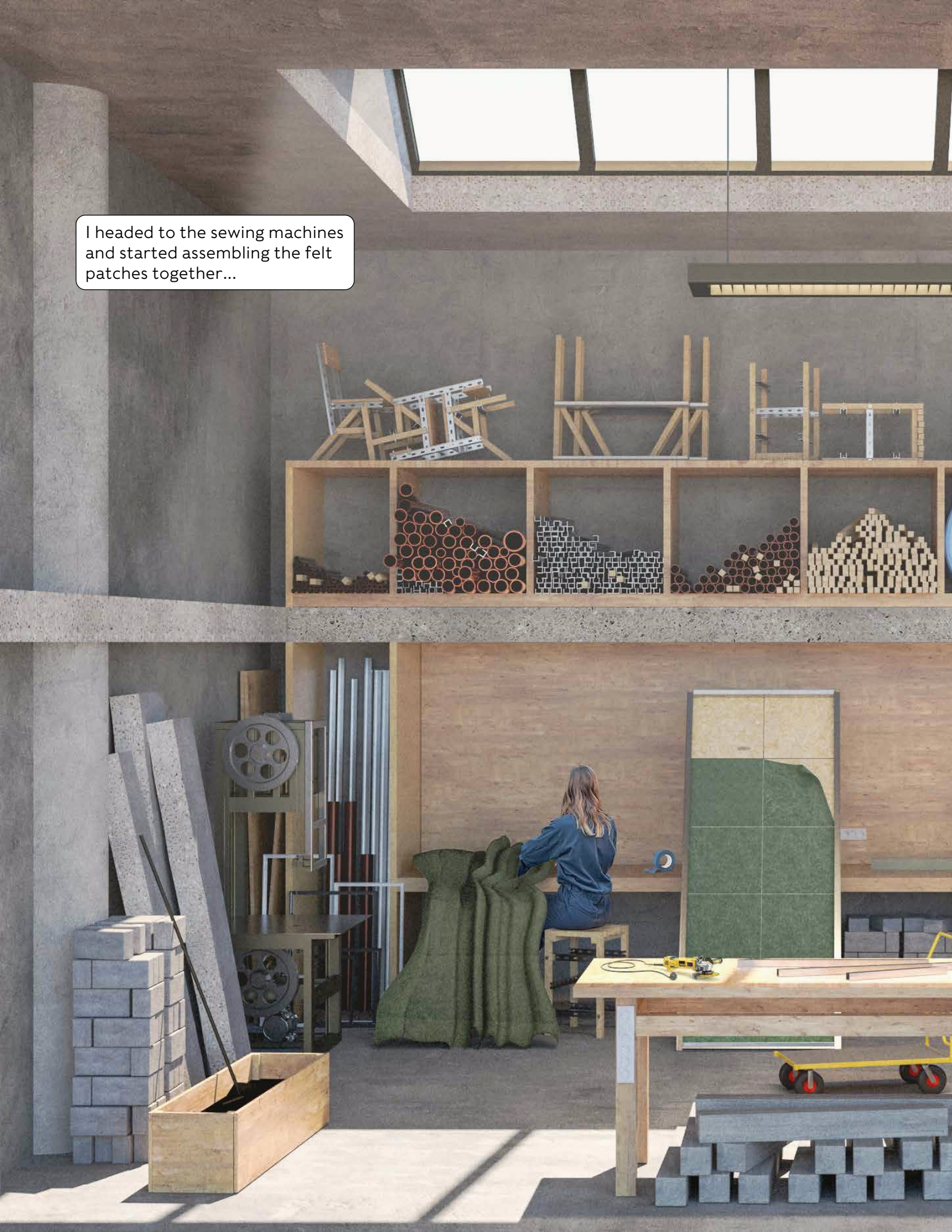
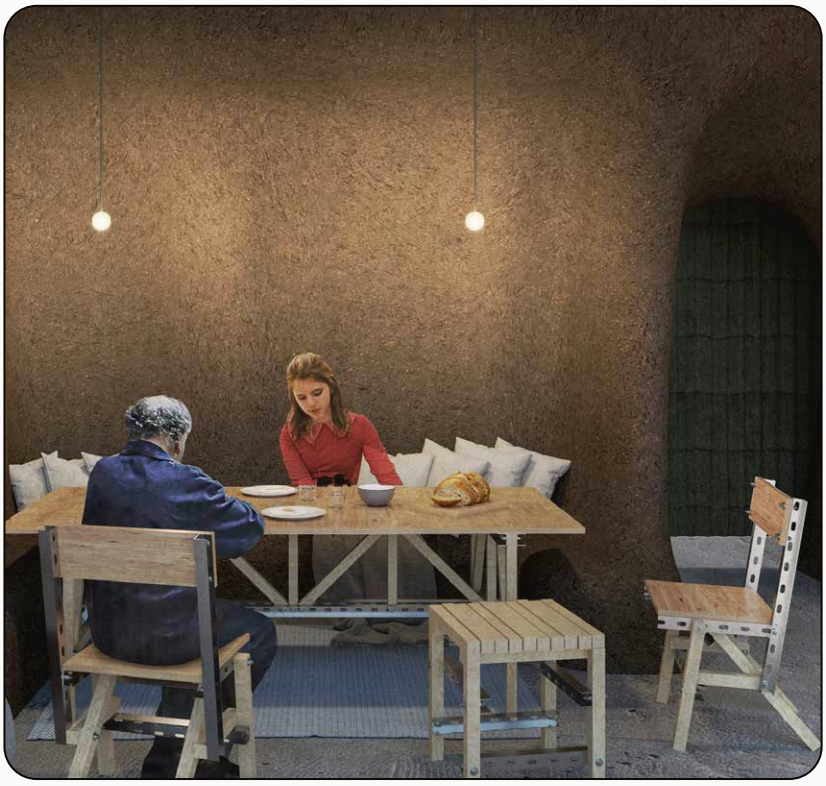

I headed to the sewing machines and started assembling the felt patches together...

CHAPTER 2

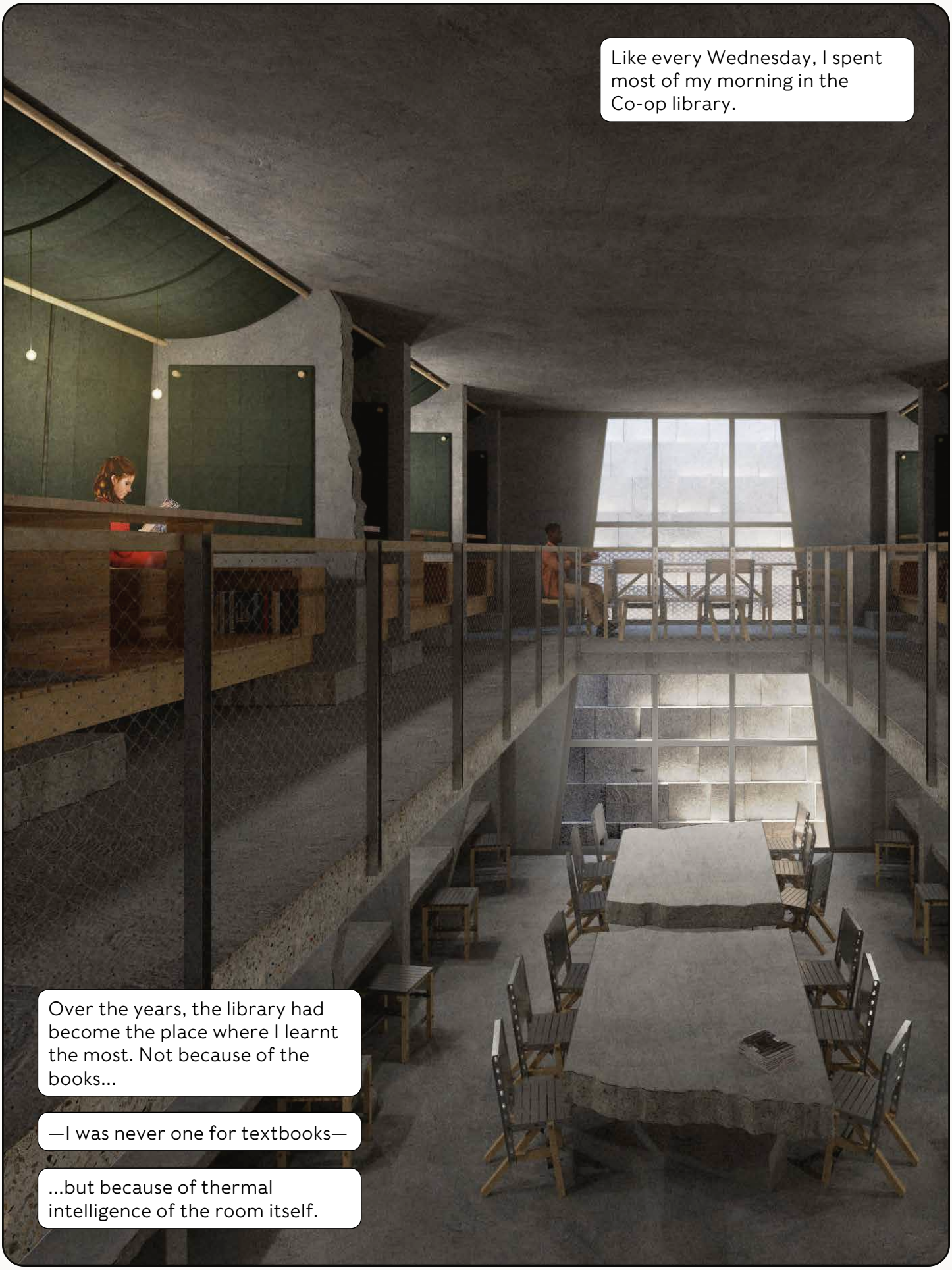
THERMAL INTELLIGENCE

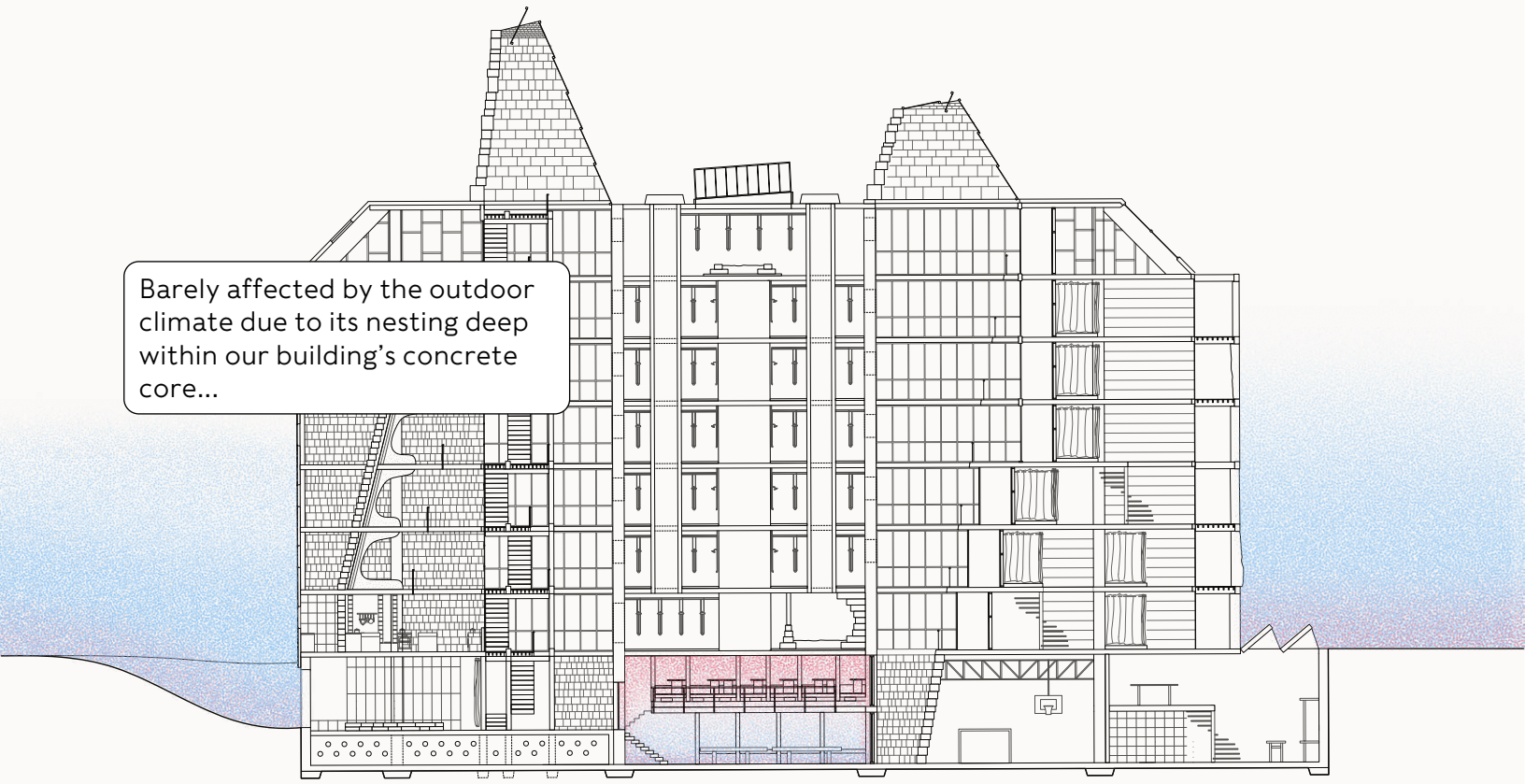
This story talks about thermal intelligence and its acquisition.
It imagines new practices of living that are aspiring to
re-entangle space, energy, and matter.

Nora - 15 years old



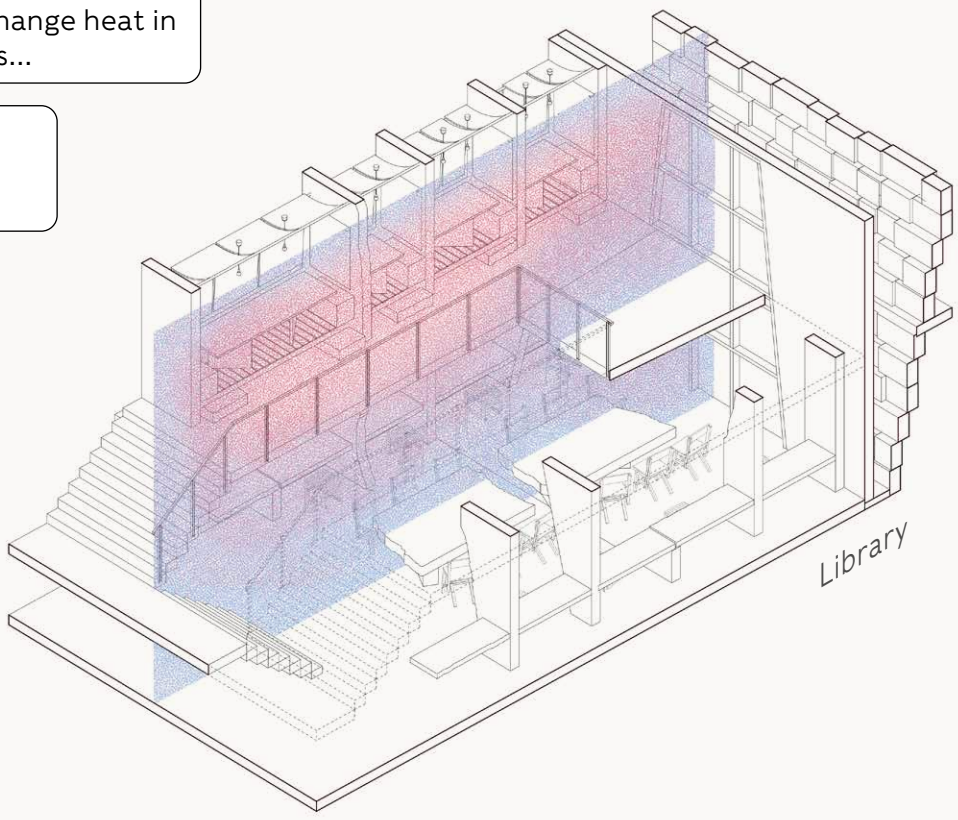
Paris, December 2029


Like every Wednesday, I spent most of my morning in the Co-op library.
Over the years, the library had become the place where I learnt the most. Not because of the books...
—I was never one for textbooks—
...but because of thermal intelligence of the room itself.

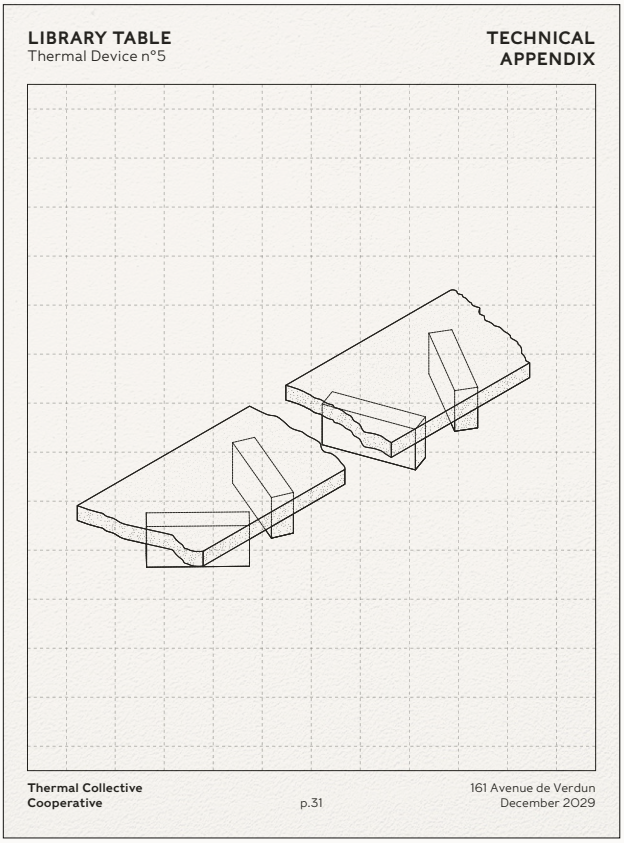


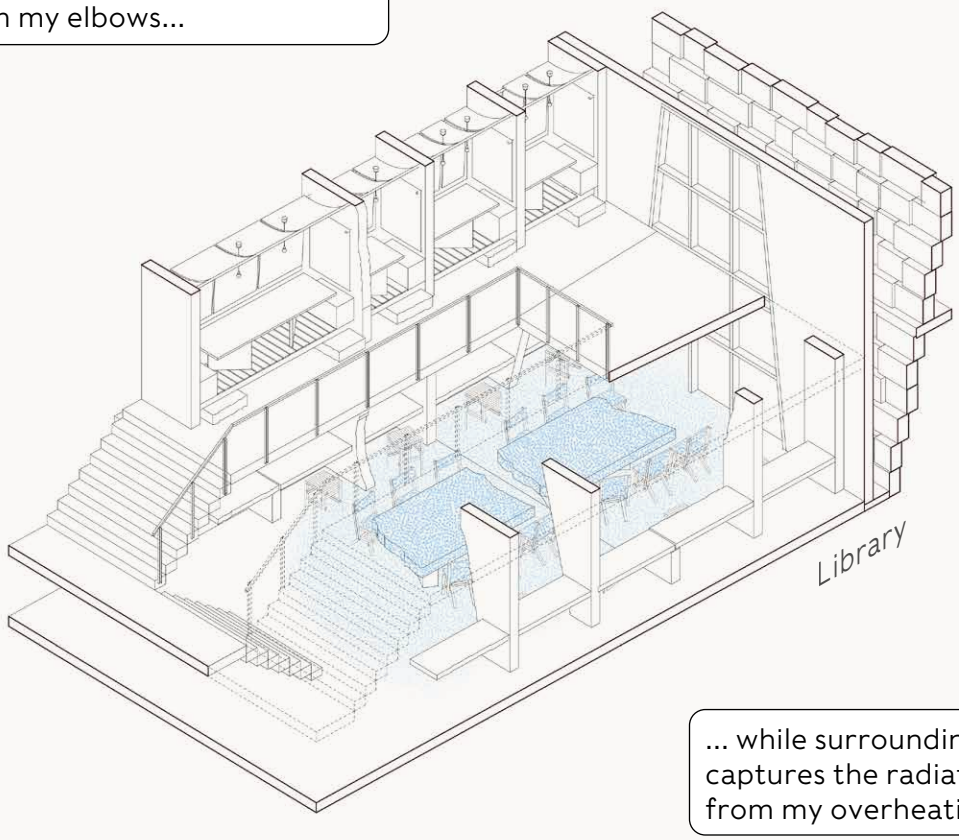
... this space taught me how different materials retain and exchange heat in drastically different ways...

... and how air separates into warmer or colder layers.



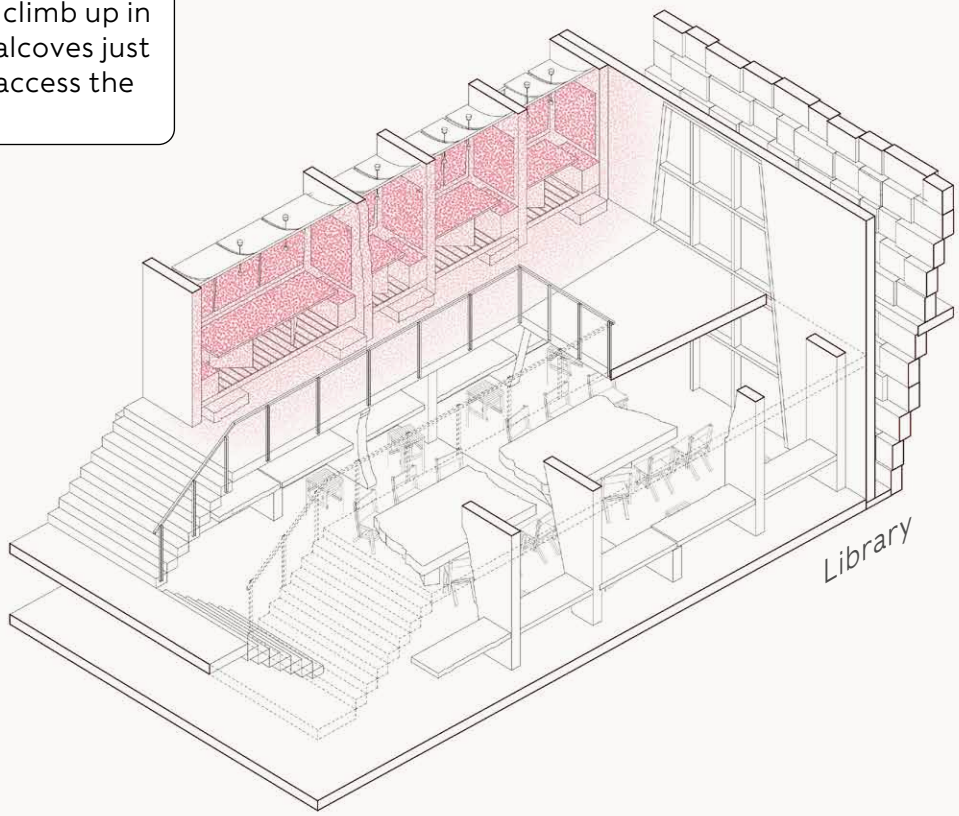
In the summer, when I sit in the fresh air of the lower level, I can feel the bare concrete table absorbing heat from my elbows...





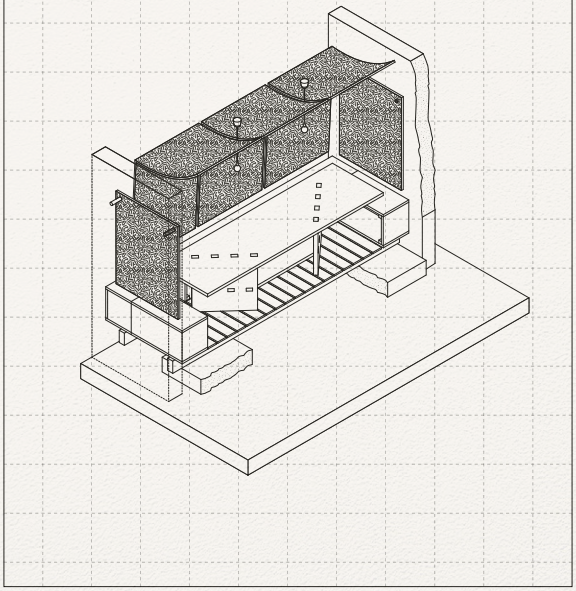
... while surrounding cold surfaces captures the radiations emanating from my overheating body.

On a cold winter day such as today, I instinctively climb up in one of the elevated alcoves just under the ceiling to access the room's warmest air.



FELT NOOK
Thermal Device n°4

TECHNICAL APPENDIX



Thermal Collective Cooperative

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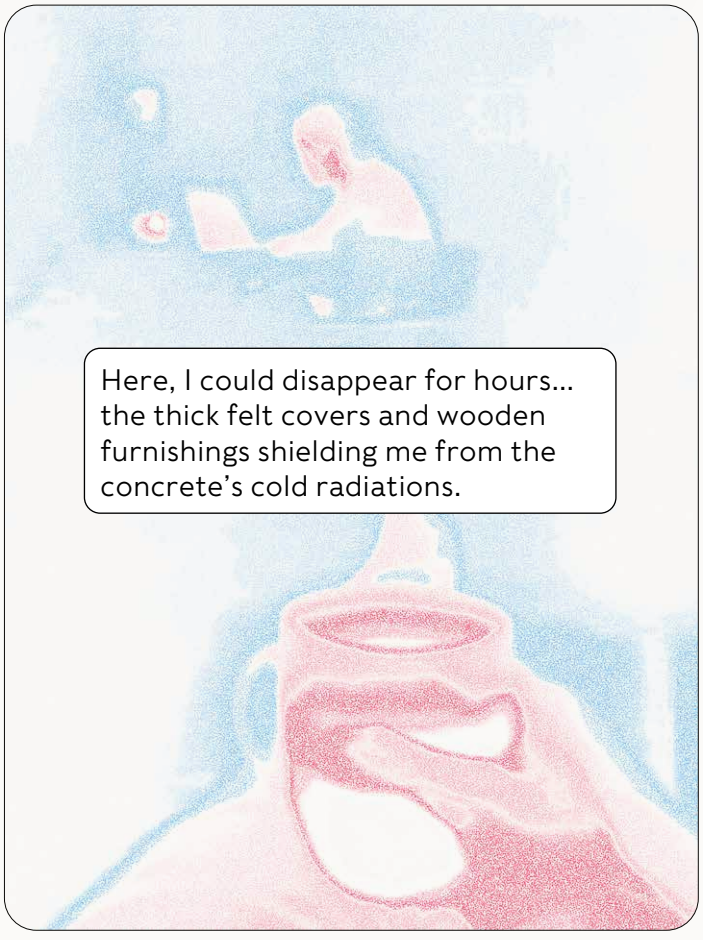
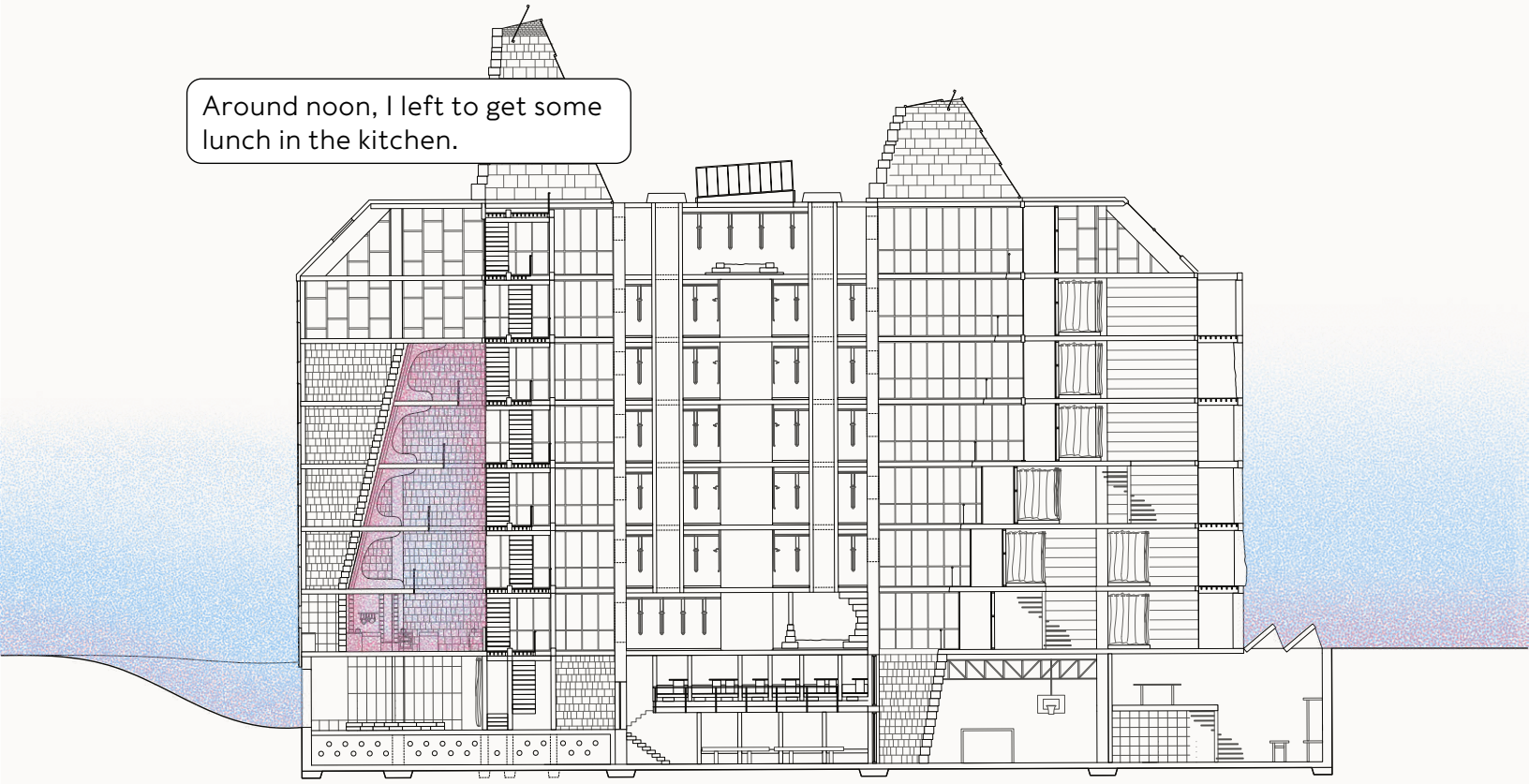
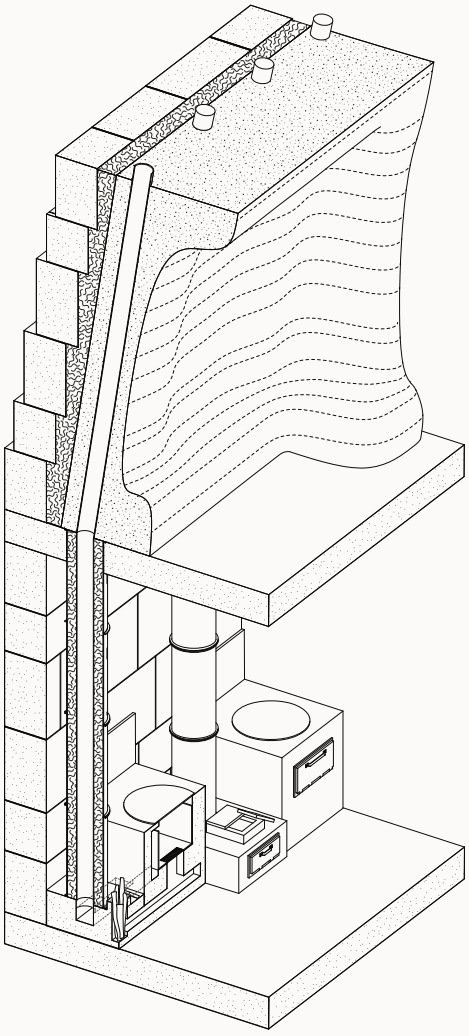
161 Avenue de Verdun
December 2029




Around noon, I left to get some lunch in the kitchen.


I shoved a few branches in one of the rocket stoves and started cracking eggs in a pan on the hot cooking plate.
Jacek asked if I could throw an extra one in for him; we often cook and eat together on Wednesdays.

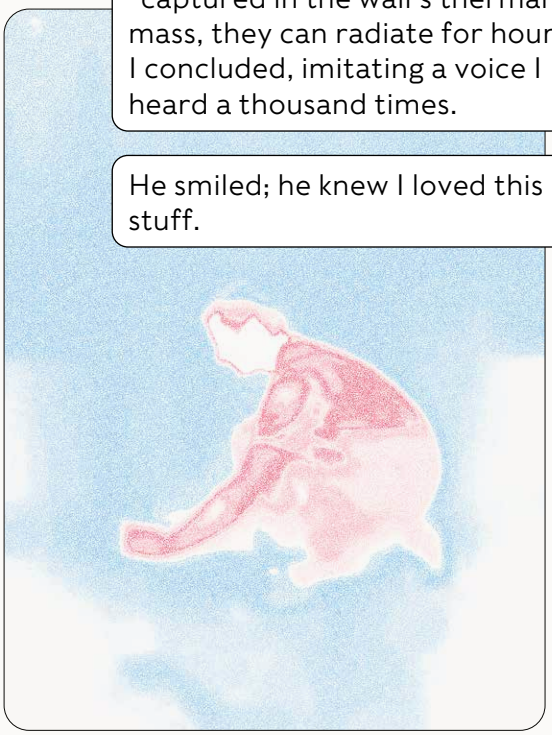
As we were sitting in the warm upper dining earthen nooks, he asked if I remembered where the heat was coming from.



Used to his constant teasing, I began to recite his explanations about the heat that comes from the wood-fired rocket stoves in the kitchen and how it circulates inside the earthen walls:

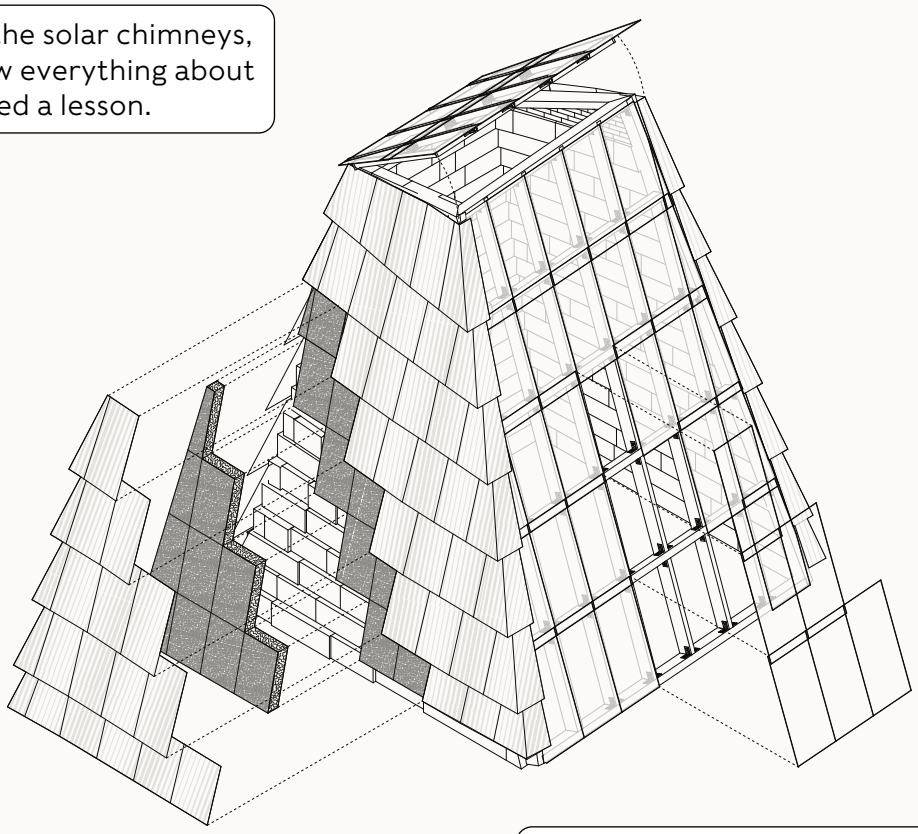
“captured in the wall’s thermal mass, they can radiate for hours”, I concluded, imitating a voice I heard a thousand times.

He smiled; he knew I loved this stuff.

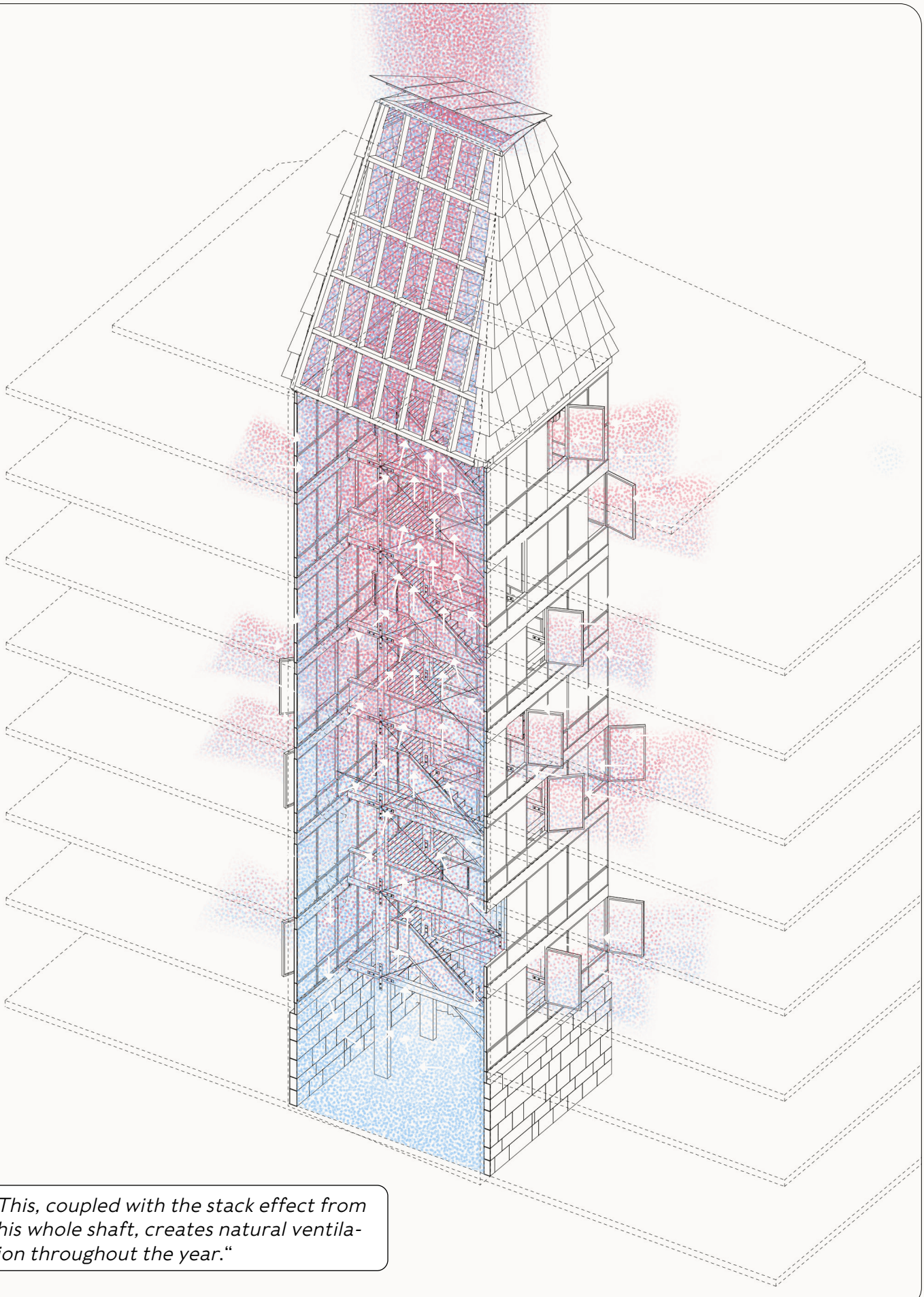


After he offered to spend some of the afternoon together, we walked up to the top of the courtyard stacks where warm and thick air had accumulated.

As we got right under the solar chimneys, Jacek, who always knew everything about energy flows, improvised a lesson.



"*The stacked concrete blocks of the chimneys collect solar radiation and heat up the air behind the glass*," he started.



"*This, coupled with the stack effect from this whole shaft, creates natural ventilation throughout the year.*"

I finally understood the origin of the air draft that kept on pulling the door open since I moved to one of the independent teenage room on the courtyard side.

Astonished to discover that those large courtyards weren't just the main circulation, but the actual lungs of the house, I wondered why they seemed closed.

"*How does the house breath?*" I asked.

Jacek smiled, and proceeded:

"*During cold waves, indoor heat is too precious for us to constantly renew our air; we still do it, but only tactically, at the warmest moment of each day.*"

"*Why do you think I brought you here in the early afternoon*," he asked with a smile, pointing at the lever against the wall.

I approached and carefully pulled it down.

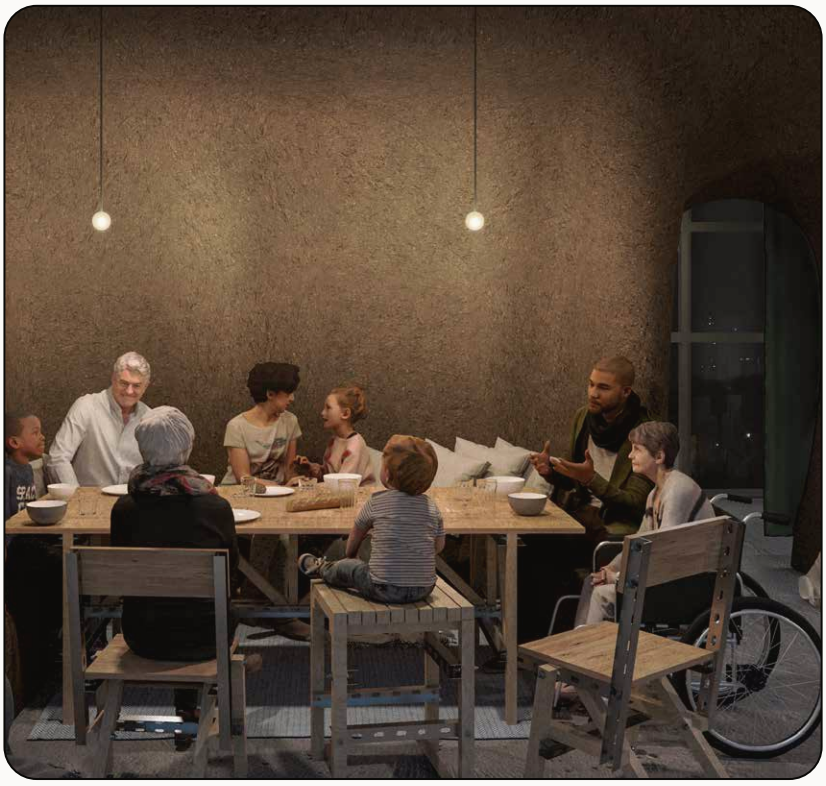
A powerful breeze suddenly pulled my hair upwards as the accumulated warm air started shooting out high into the cold blue sky above.

CHAPTER 3

THERMAL COLLECTIVE

This story talks about the thermal, seasonal and collective aspects of comfort —and discomfort— and questions what it means to be comfortable.

Marc - 57 years old



Paris, February 2030

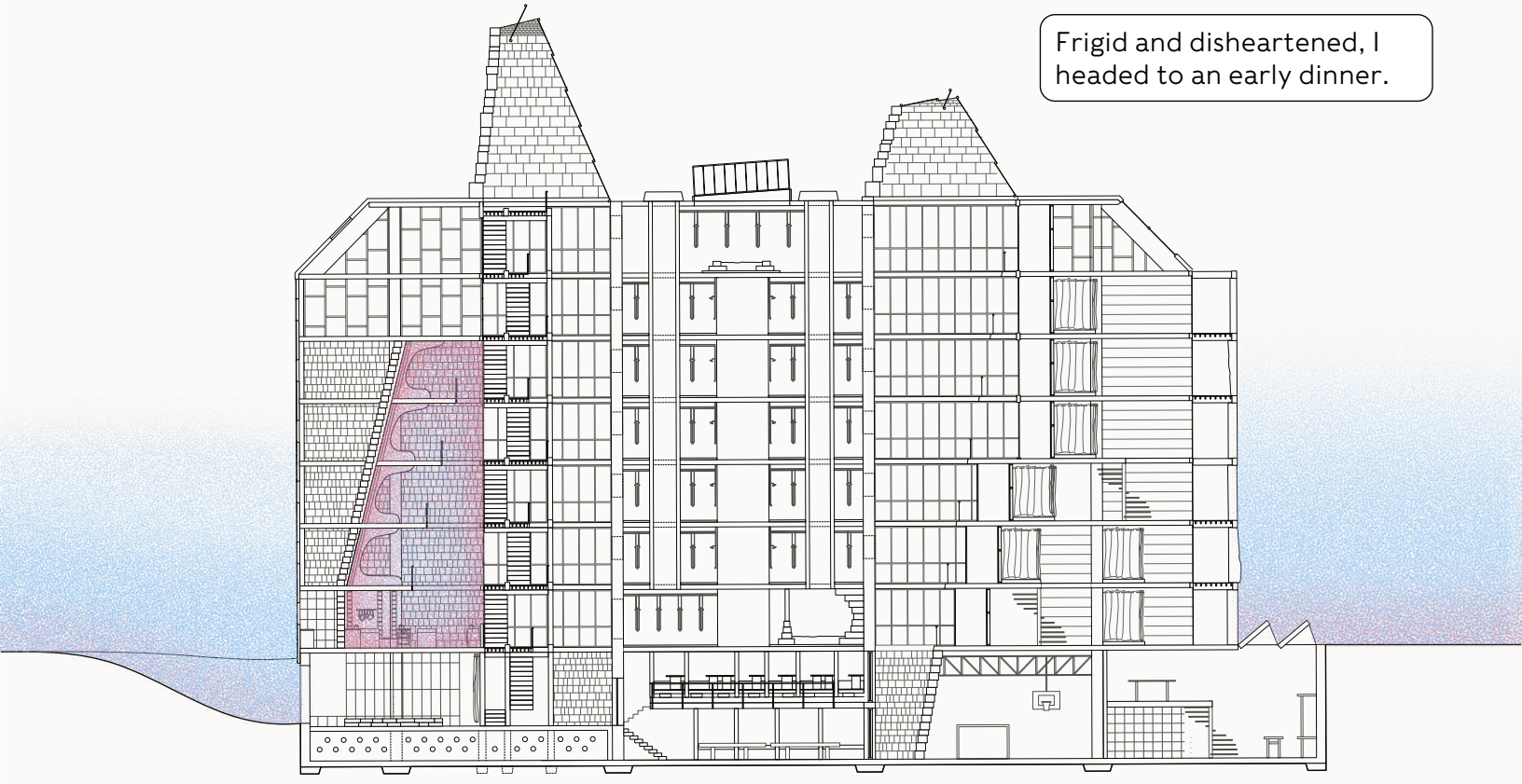
I was walking quickly towards our house on this cold and dark winter afternoon...

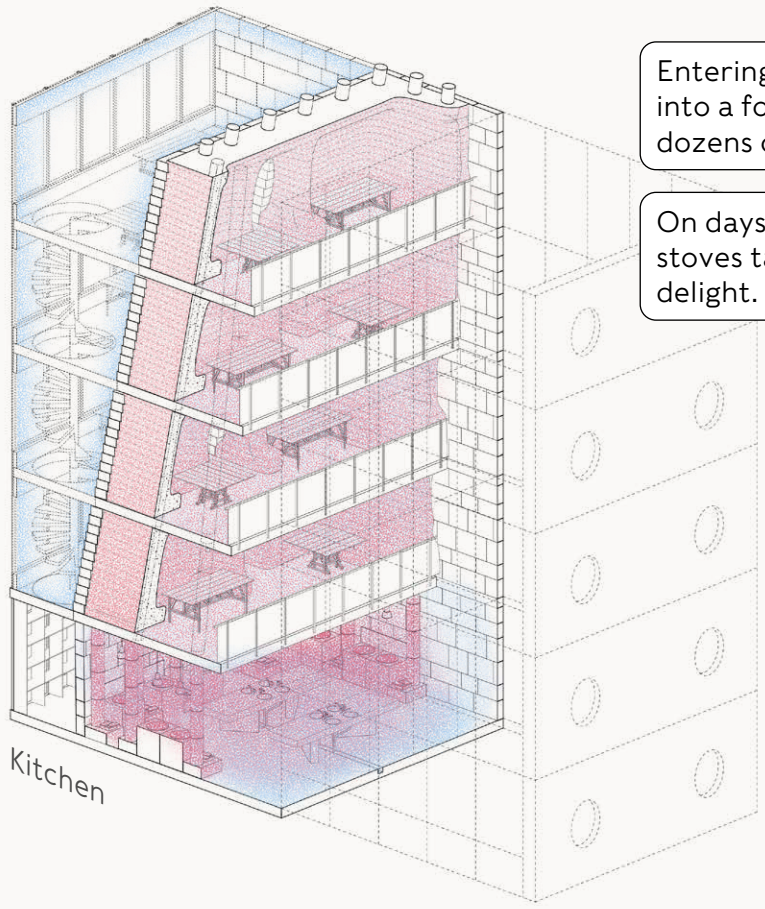
All its lights looked strangely dimmed; today was the planned power cut.

With one of the coldest waves of the year hitting the city, the Co-op was going into a low energy regime to avoid soaring energy prices.

Showering was not an option; domestic hot water was reserved for toddlers and elders.

Frigid and disheartened, I headed to an early dinner.





Entering the kitchen was like stepping into a forge; every stove was on, and dozens of people were cooking.

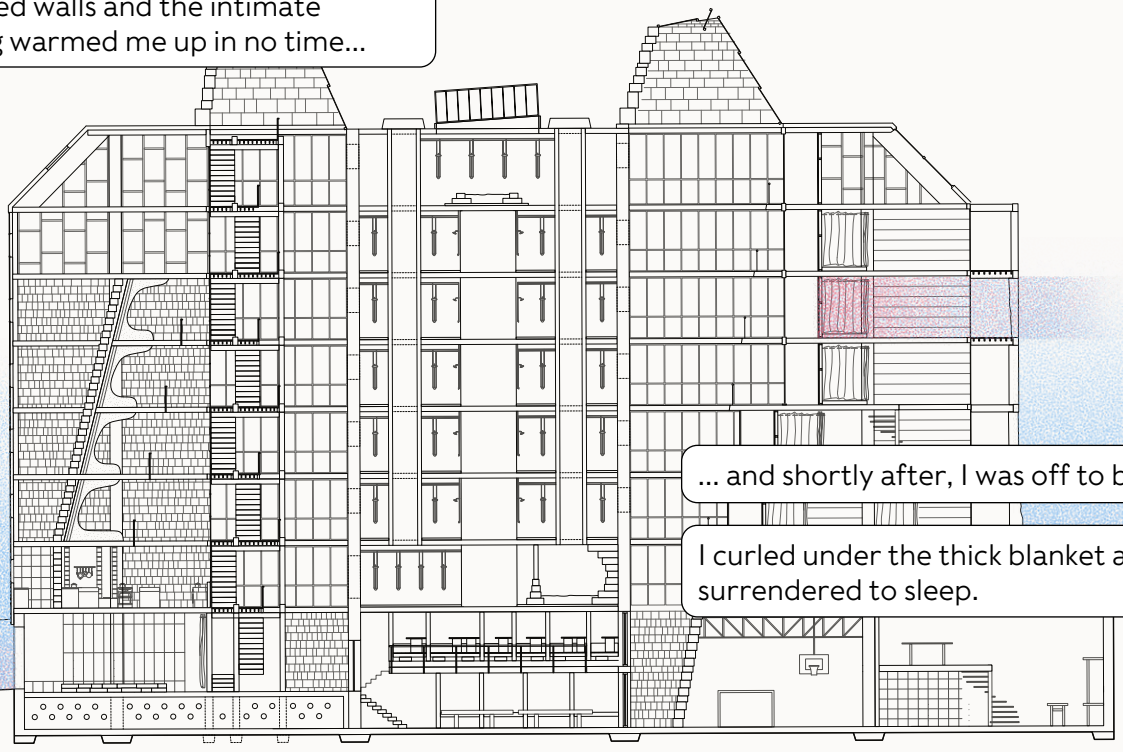
On days like these, the kitchen wood stoves take over and make this space a delight.

I was reluctant to start cooking among the happy mess of children running around and busy cooks trying to keep track of their pots.

Luckily, Nora, who saw me dazed in the entrance, waved at me and offered me to join her family dinner.

We sat in an earthen alcove of the dining area, where another family had already settled. Grateful for their thermal hospitality, I grabbed a bowl of soup.

The heated walls and the intimate gathering warmed me up in no time...



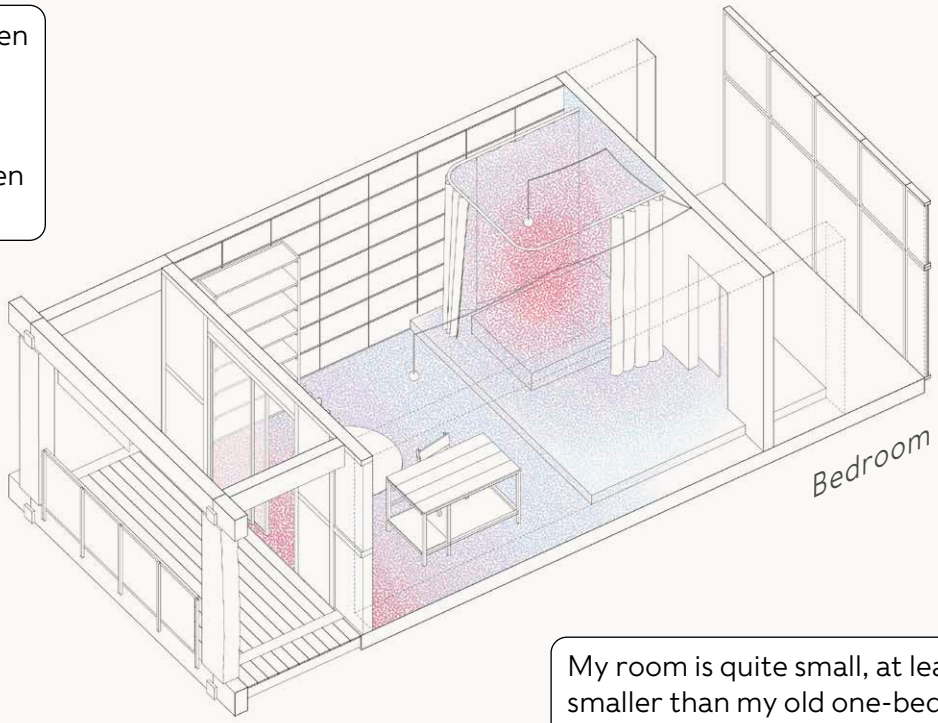
... and shortly after, I was off to bed.

I curled under the thick blanket and surrendered to sleep.

I woke up on a bare mattress; the radiant heat had accumulated behind the thick felt curtains around my bed and made the blanket redundant halfway through the night.

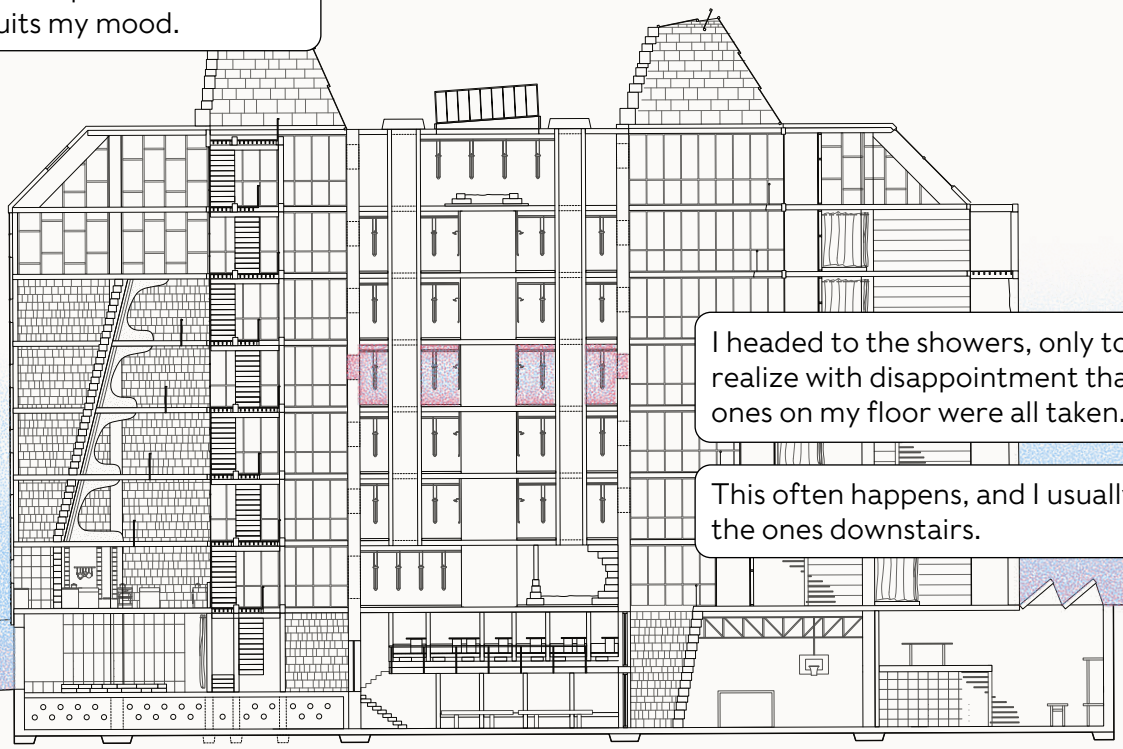
I pulled the curtains, and my senses were hastily awakened; bright sunlight poured in quickly, followed by a gust of cold air.

I stepped out of the wooden deck, prepared a coffee, and proceeded to sip it by the window on the warm concrete slab that had been under the sun for a while.



My room is quite small, at least twice smaller than my old one-bedroom apartment used to be. When I moved, it felt a bit suffocating at first...

...now, I know I can move around the building to find the space and thermal comfort that suits my mood.

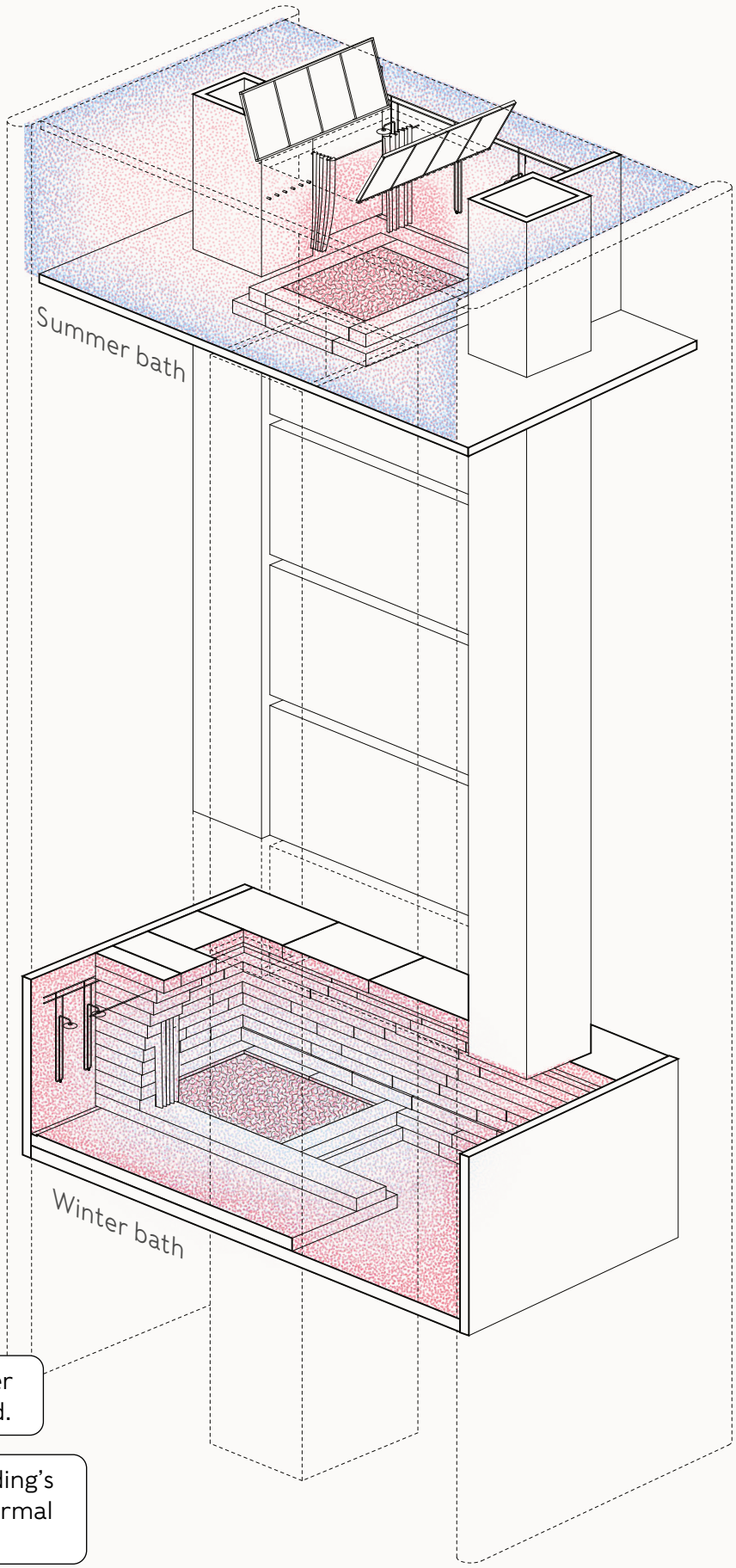


I headed to the showers, only to realize with disappointment that the ones on my floor were all taken.

This often happens, and I usually go to the ones downstairs.

But, I thought, why not visit the bath today?

In the warmer season, I gladly spend time in the summer bath: it opens to the outside air and that's where I typically catch up with everyone.



I more rarely go to the winter bath, which is more confined.

Nested deep within the building's basement, it's where the thermal inertia is the strongest.

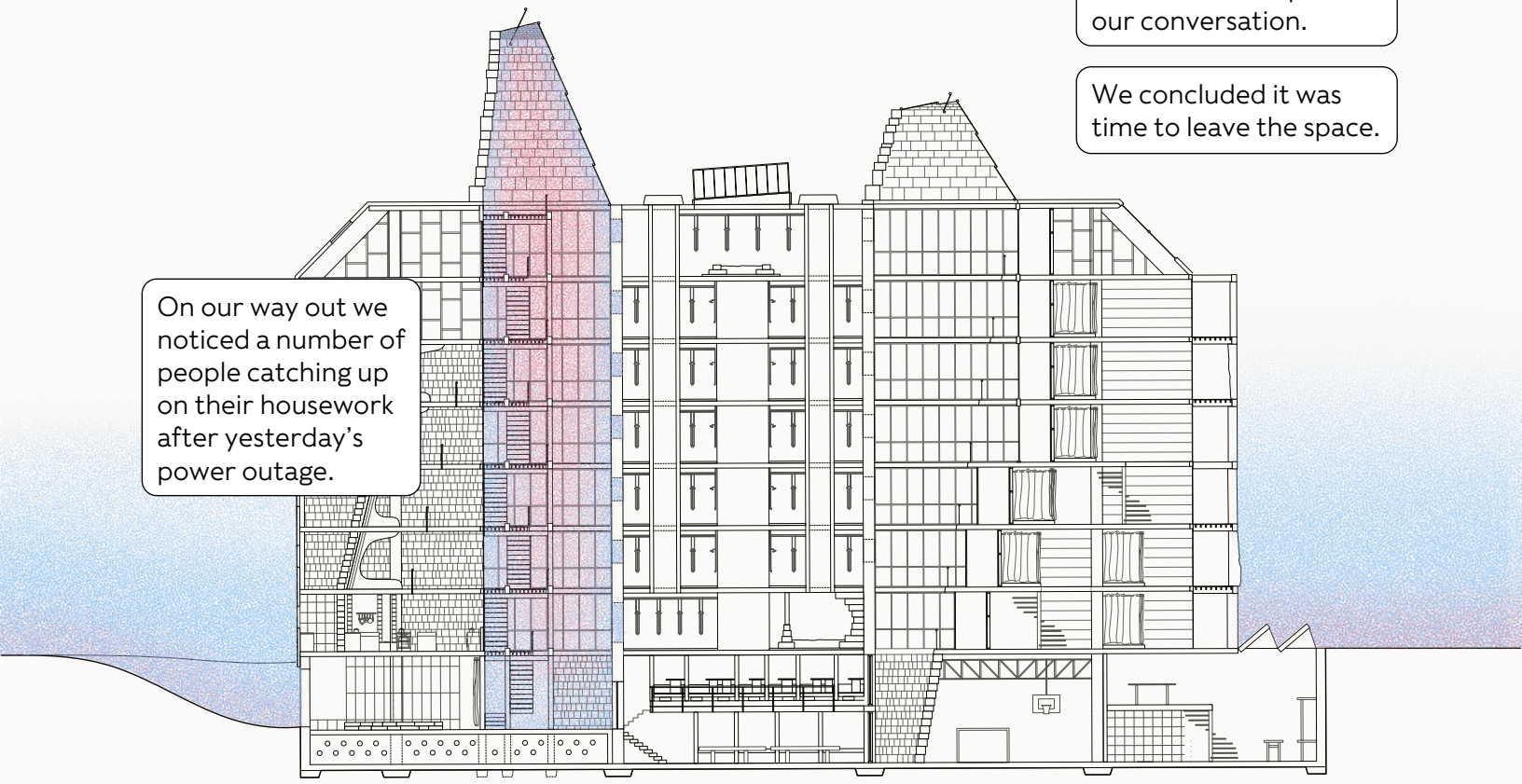
The bath is shaped by stacked blocks of concrete and looks like a small cave retaining the heat emanating from the warm water.

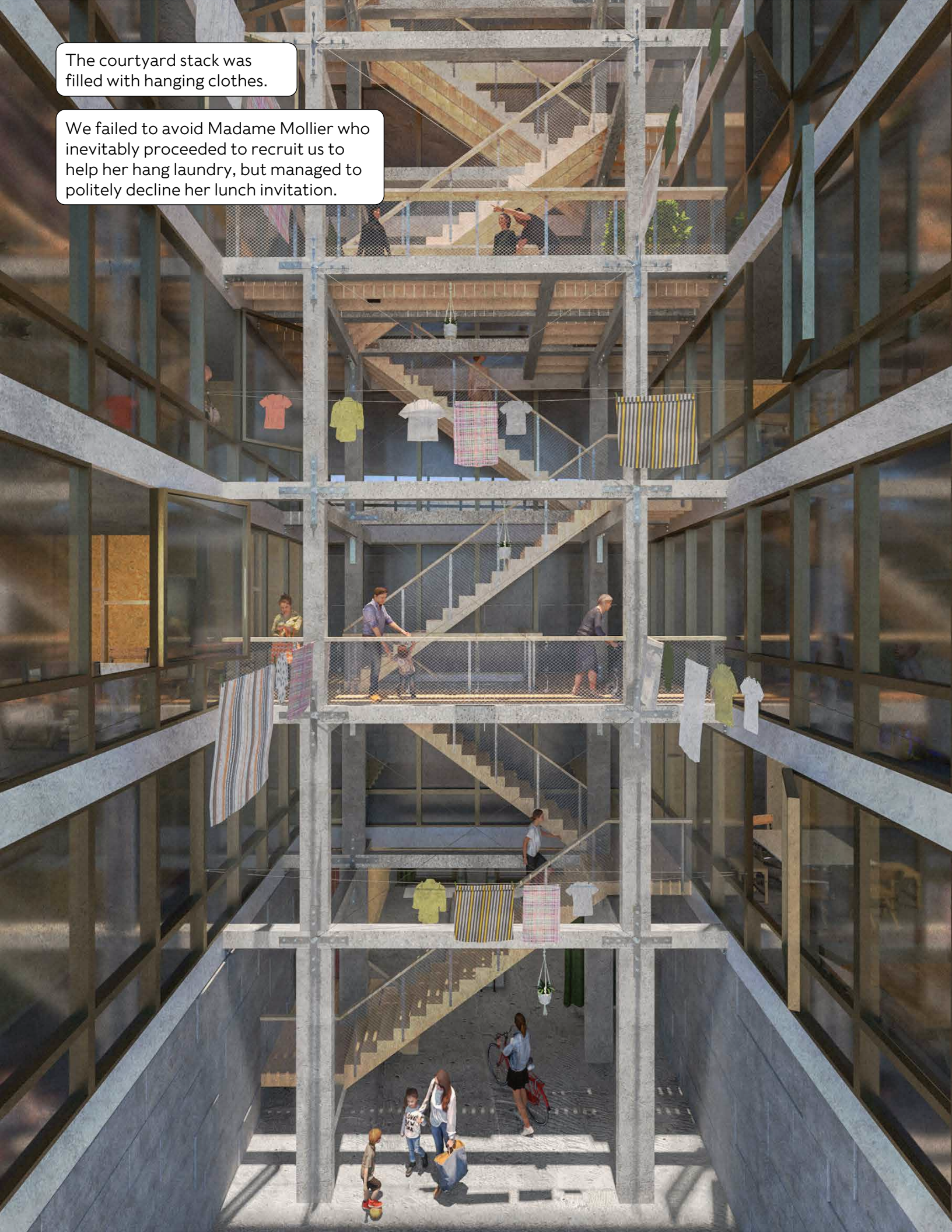
When I got there, I was glad to see Alix among a few older people, and I sat by their side.

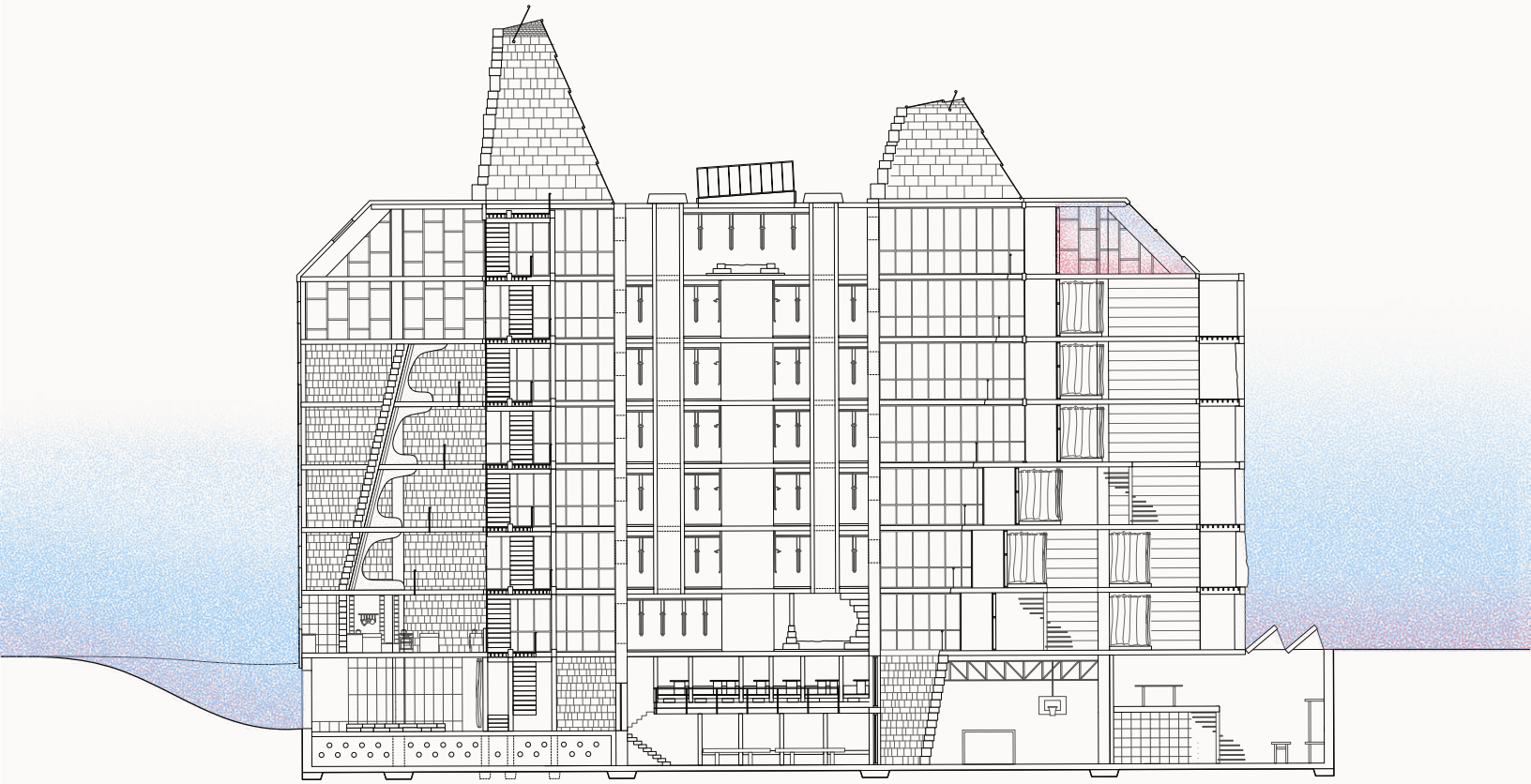
We talked about the building's recent drop in temperature and our favorite places to stay warm in this season, until the chatter of adolescents entering the bath interrupted our conversation.

We concluded it was time to leave the space.

On our way out we noticed a number of people catching up on their housework after yesterday's power outage.



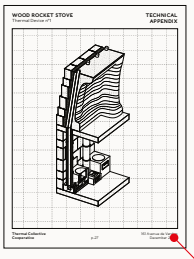

The courtyard stack was filled with hanging clothes.
We failed to avoid Madame Mollier who inevitably proceeded to recruit us to help her hang laundry, but managed to politely decline her lunch invitation.

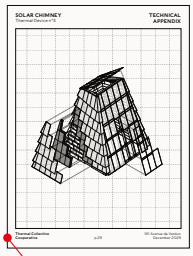


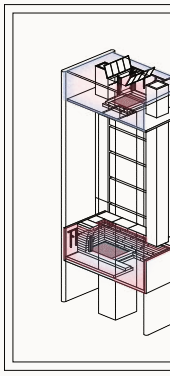
Here Alix and I joined the warm crowd that had gathered under the sun of this winter afternoon.

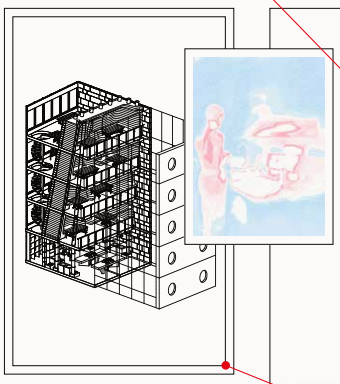
Sharing the heat... As always.

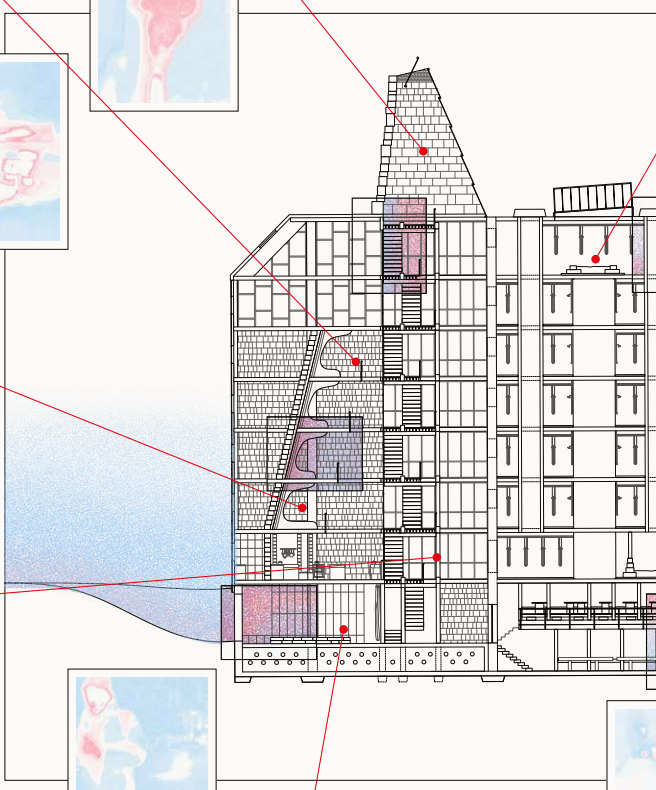
To be continued...

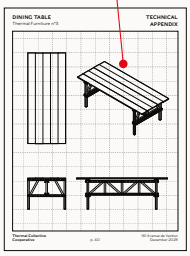

WOOD ROCKET STOVE
TECHNICAL APPENDIX

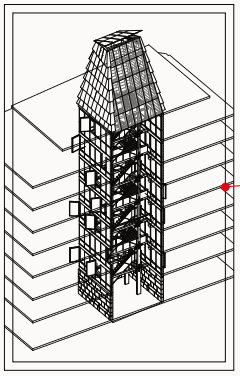

SOLAR CHIMNEY
TECHNICAL APPENDIX

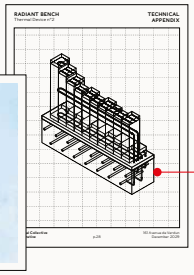


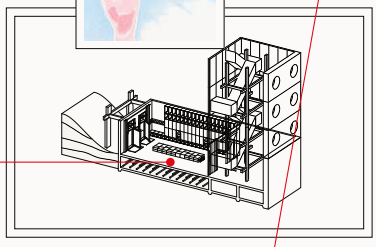


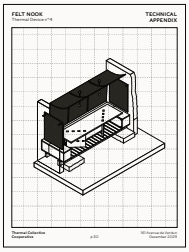


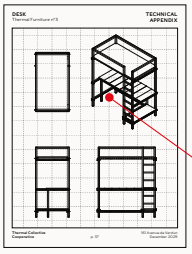

DINING TABLE
TECHNICAL APPENDIX

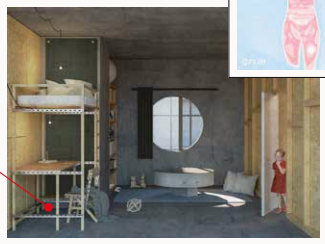


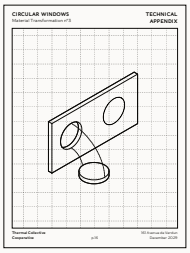

RADIANT BENCH
TECHNICAL APPENDIX




FELT NOOK
TECHNICAL APPENDIX


DESK
TECHNICAL APPENDIX




CIRCULAR WINDOWS
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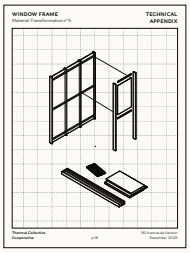
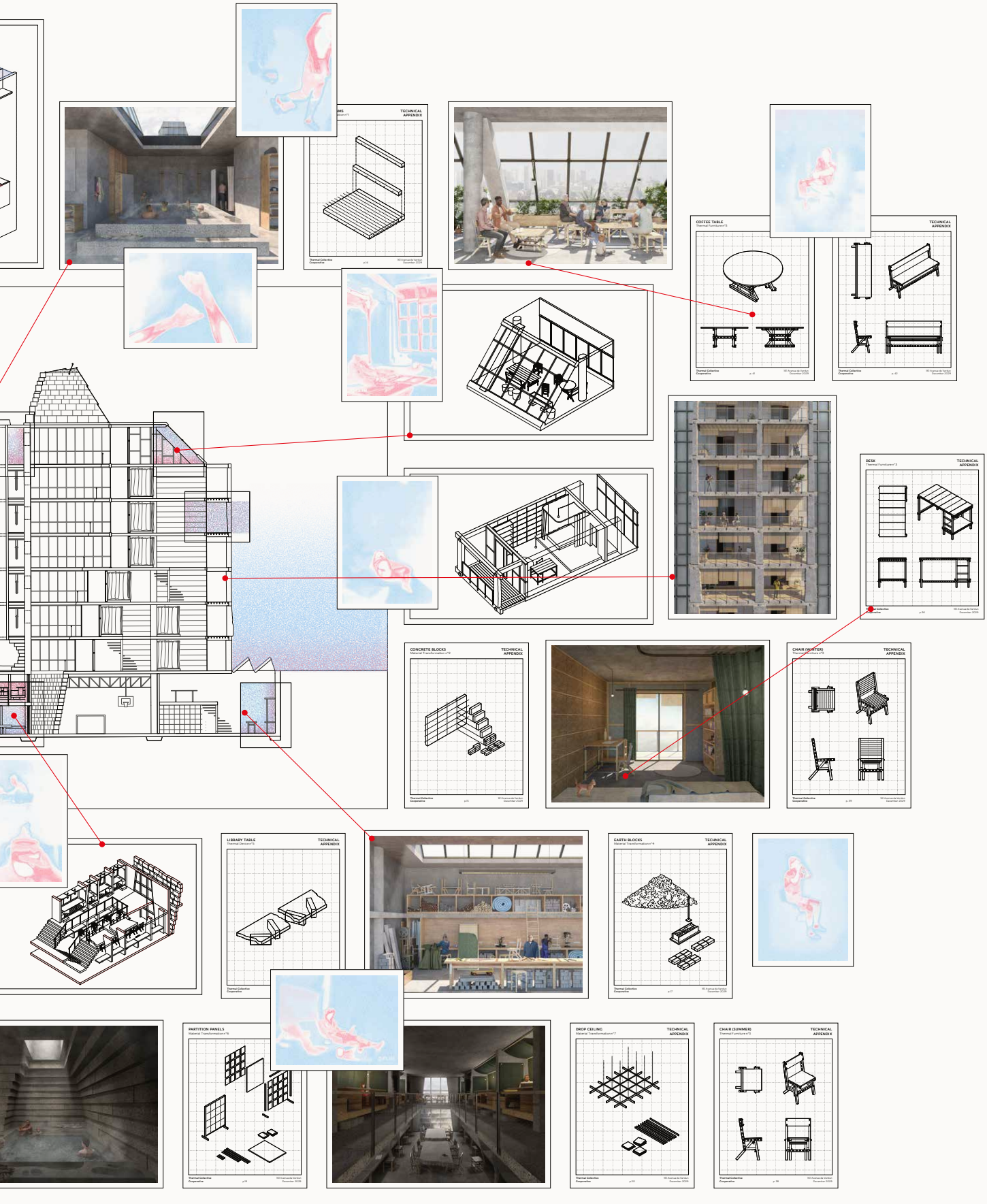

WINDOW FRAME
TECHNICAL APPENDIX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Thermal Furniture n°8
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DESK
Thermal Furniture n°9
TECHNICAL APPENDIX
CONCRETE BLOCKS
Material Transformation n°2
TECHNICAL APPENDIX
CHAIR (WINTER)
Thermal Furniture n°5
TECHNICAL APPENDIX
LIBRARY TABLE
Thermal Device n°10
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EARTH BLOCKS
Material Transformation n°4
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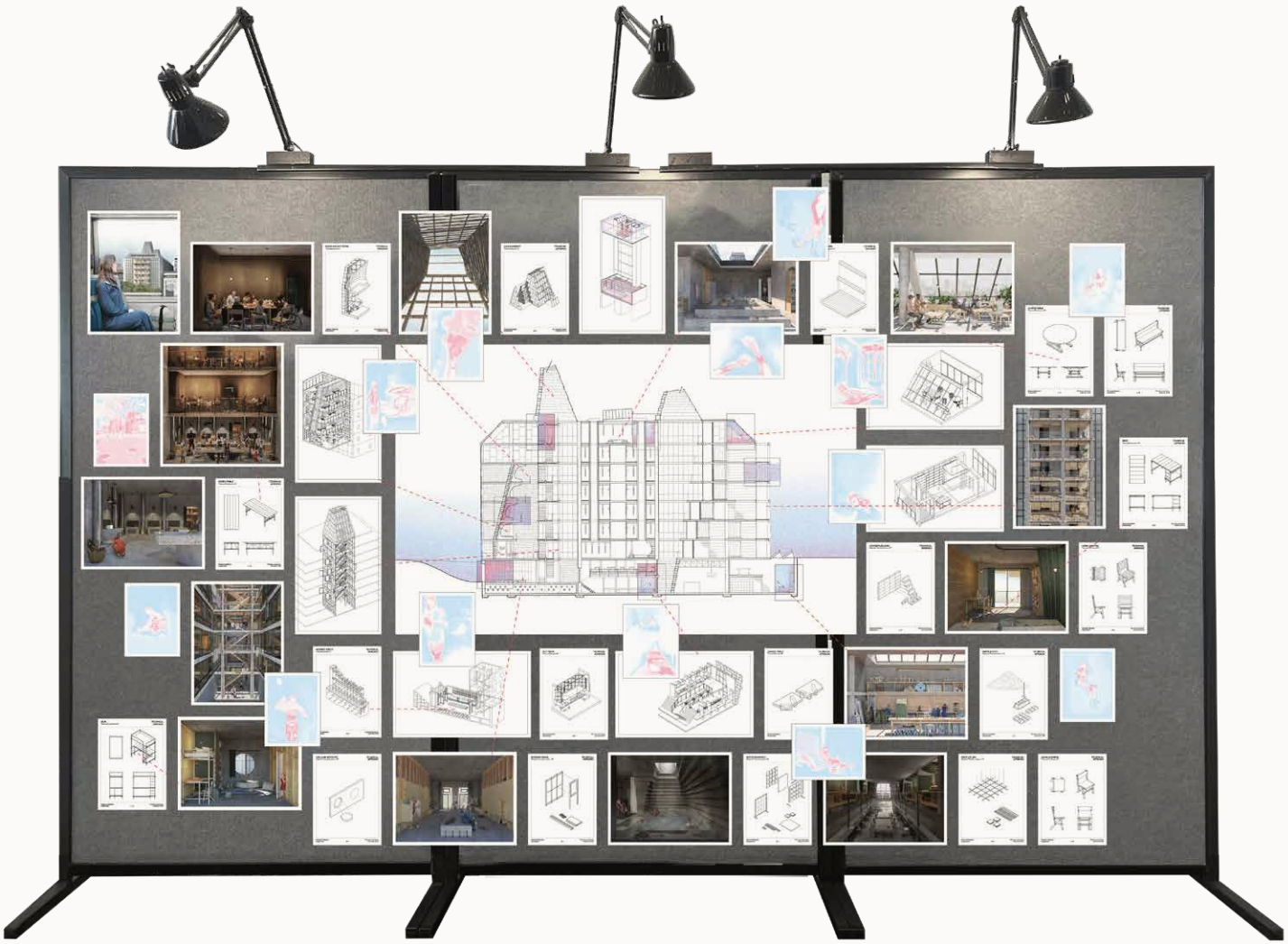
PARTITION PANELS
Material Transformation n°6
DROP CEILING
Material Transformation n°7
TECHNICAL APPENDIX
CHAIR (SUMMER)
Thermal Furniture n°5
TECHNICAL APPENDIX



AFTERWORD

This thesis interrogates our current building and dwelling practices and the material and energetic consumptions with which they are associated. It calls for new forms of comfort based on the development of a thermal intelligence that requires new sets of knowledge, skills, practices and priorities.

Today, modern comfort has been universally formalized in building codes as an indoor air temperature between 19.5°C and 27°C, with no considerations for all alternative material properties; and these standards are applied everywhere in Europe regardless of the diverse realities of climate and geography. Office buildings like the one our Thermal Collective adapted are the widespread products of this modern thermal paradigm; a paradigm that, as we know today, turned the built environment into the single most CO2 emitting industry on the planet.

As a response to emissions, the building industry in Europe has massively promoted efficiency measures as exemplified in models like PassivHaus —a better version of the same modern paradigm— rather than changes in behavior and consumption. However, recent history has shown that the gains of efficiency tends to be offset by the increase in consumption that they enable.

As the IPCC 6th assessment report on climate change mitigation has stated in 2022, operational efficiency alone is not enough. The notion of sufficiency, is a preferable target for future building practices.

The stories you have heard outline a possible near-future sufficiency through three co-acting and entangled aspects: Living with Thermal Properties and Climate, Collectivizing Living Spaces and the application of Thermal Intelligence to Materials Ethics. These principles cannot be applied to our living environments through a quick or clean, fix. They imply a deeper requalification of our cultural lingering attachment to modern comfort and its energetic, material and spatial consequences.

As Daniel Barber reminds us, in light of the ongoing climate emergency, « *we will be discomforted either by design or by default.* » We are today in urgent need of architectural imaginaries that offer perspectives beyond the wasteful modern paradigm. Through the stories it tells, this thesis seeks to highlight the opportunities but also the frictions, the gains and losses that emerge when we collectively leave modern comfort behind.


Concrete
Conductivity : 3.6 W/mK
Heat Capacity : 2086 J/m³K


Rammed Earth
Conductivity : 1.25 W/mK
Heat Capacity : 870 J/m³K

Part 3

BACK MATTER

THESIS DEFENSE

THERMAL STORIES

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APPENDIX

Physical Models
Architectural Renders
Thermal Spaces
Thermal Furnitures
Thermal Devices
Material Re-arrangements
Thermal Images
Supporting documents

THESIS DEFENSE

DEFENSE

The Thesis defense took place at the MIT Media Lab, on December 22nd 2022. We are beyond grateful for all the faculties, friends and family who made themselves available for it, in person or on Zoom. Our three thermal stories were read by Samantha Ratanarat, Simmone Stearn and Garnette Cadogan.

PANEL

Reviewers

Alpha Yacob Arsano	Northeastern College of Arts Media and Design
Beatriz Colomina	Princeton School of Architecture
Caroline Jones	MIT SA+P, History, Theory and Criticism
Christoph Reinhart	MIT SA+P, Building Technology Group
Garnette Cadogan	MIT SA+P, Urban Studies and Planning
Jenny French	Harvard Graduate School of Design
Ivonne Santoyo Orozco	Bard College
Lauren Pacheco	University of Chicago

Committee

Caitlin Mueller	MIT SA+P, Building Technology Group
Kiel Moe	Northeastern University
Sheila Kennedy	MIT SA+P, Architecture and Urbanism
Timothy Hyde	MIT SA+P, History, Theory and Criticism

Figure 37. *Thesis defense, December 22nd 2022, MIT Media Lab*

Figure 38. *Thesis defense, December 22nd 2022, MIT Media Lab*

Figure 39. *Thesis defense, December 22nd 2022, MIT Media Lab*

Figure 40. *Thesis defense, December 22nd 2022, MIT Media Lab*

THERMAL STORIES

THERMAL STORY 01
Read by Samantha Ratanarat

Chiara - August 2029, Paris

I work cutting concrete slabs in the old office buildings south of Paris. Today, as I was riding the tram home, I recalled the time when I was working on the construction site that became the co-op where I now live. That was my first job as a concrete sawyer. It felt a bit messy and overwhelming at the time. We started by partially disassembling the curtain wall facade, then we made a few excavations in front of the building while some roofing was removed. But mostly, we cut a lot of concrete to create new entrances and allow light and air to reach the lower levels of the building through the courtyards. It was only after completing the job that I realized how essential these material re-arrangements had been in transforming the deep office floor plates into spaces for living.

In my previous job as a demolition laborer, materials crumbled under the force of the machines and were immediately disposed of off-site. But with the new C&D waste laws, it seemed in the co-op's best interest to keep and reuse everything, even the former office fit-outs, which, at the time, looked worthless to everyone on our team. All materials, however, were carefully disassembled and stored in the former parking levels. Down there, they were transformed. Slabs were cut into beams, walls into chunks, windows disassembled, and earth compressed into blocks. Eventually, materials were moved throughout the building to redefine its infrastructure. I particularly remember the audacious assembly of the new balconies. Put together by stacking re-arranged concrete chunks against the facade, they provide bedrooms with a thermal buffer in the winter and shade in the summer.

The tram came to a halt with a long squeak. It was my stop. Under the blazing sun, the short walk from the station to the co-op felt like a never-ending desert. I sighed in relief when I finally walked down the entrance, anticipating the fresh sunken lobby waiting for me. I collapsed on the bench, took off my working boots and construction jacket, and laid back against the cold concrete. The space was always a bit crowded, but it made a good thermal buffer. Chills rushed through my body as the usual indoor draft brushed my sticky skin. I stayed for a while, remembering when we saw out and excavated the entrance opening. Below, the basement was partly filled with the excavated soil to support our building's geothermal water heat-exchanger. The entrance's concrete offcuts were used to create a radiative bench. With running geothermal water to keep it cool in summer and warm in winter, it stands as the central thermal piece of this transition space.

After my work as a contractor was done, I joined the coop myself, taking one of the last few rooms available. As was the custom, I continued being involved in the construction work, but this time as a co-op member responsible for the house's fit-outs. Developing the skills and agency to maintain the space in which I live is empowering —in essence, we are in full control— although, somedays it feels like things break faster than we can repair them, and that this building collective will forever remain an unfinished project.

The thought of my ongoing commitments in the workshop threw me back to reality. I skipped a shower and headed there. I felt the usual tinge of bewilderment while looking at the shelves full of salvaged office materials. Pipes, carpet tiles, aluminum extrusions, boards disassembled from tabletops, doors, frames, and all kinds of wooden studs… The abundance provided by what would have otherwise been wasted never failed to amaze me. A few people were there. Jacek waved at me from behind a mountain of wooden scraps and aluminum extrusions, he was making more summer chairs for the common areas, using aluminum profiles with high thermal conductivity for the seat and back rest. Part of my coop work this season was to expand the winter tapestries for the library using felt panels from the old office partitions. I headed to the sewing machines and started assembling the felt patches together.

THERMAL STORY 02
Read by Simmone Stearn

Noora - December 2030, Paris

Like every Wednesday, I spent most of my morning in the Co-op library. Over the years, the library had become the place where I learnt the most. Not because of the books--I was never one for textbooks-- but because of thermal intelligence of the room itself. Barely affected by the outdoor climate due to its nesting deep within our building's concrete core, this space taught me how different materials retain and exchange heat in drastically different ways and how air separates into warmer or colder layers. In the summer, when I sit in the fresh air of the lower level, I can feel the bare concrete table absorbing heat from my elbows while surrounding cold surfaces captures the radiations emanating from my overheating body. On a cold winter day such as today, I instinctively climb up in one of the elevated alcoves just under the ceiling to access the room's warmest air. Here, I could disappear for hours…the thick felt covers and wooden furnishings shielding me from the concrete's cold radiations.

Around noon, I left to get some lunch in the kitchen. I shoved a few branches in one of the rocket stoves and started cracking eggs in a pan on the hot cooking plate. Jacek asked if I could throw an extra one in for him; we often cook and eat together on Wednesdays. As we were sitting in the warm upper dining earthen nooks, he asked if I remembered where the heat was coming from. Used to his constant teasing, I began to recite his explanations about the heat that comes from the wood-fired rocket stoves in the kitchen and how it circulates inside the earthen walls: "captured in the wall's thermal mass, they can radiate for hours", I concluded, imitating a voice I heard a thousand times. He smiled; he knew I loved this stuff.

After he offered to spend some of the afternoon together, we walked up to the top of the courtyard stacks where warm and thick air had accumulated. As we got right under the solar chimneys, Jacek, who always knew everything about energy flows, improvised a lesson. The stacked concrete blocks of the chimneys collect solar radiation and heat up the air behind the glass, he started. This, coupled with the stack effect from this whole shaft, creates natural ventilation throughout the year.

I finally understood the origin of the air draft that kept on pulling the door open since I moved to one of the independent teenage room on the courtyard side. Astonished to discover that those large courtyards weren't just the main circulation, but the actual lungs of the house, I wondered why they seemed closed. "How does the house breath?" I asked. Jacek smiled, and proceeded; during cold waves, indoor heat is too precious for

us to constantly renew our air; we still do it, but only tactically, at the warmest moment of each day. Why do you think I brought you here in the early afternoon, he asked with a smile, pointing at the lever against the wall. I approached and carefully pulled it down. A powerful breeze suddenly pulled my hair upwards as the accumulated warm air started shooting out high into the cold blue sky above.

THERMAL STORY 03
Read by Garnette Cadogan

Marc - February 2031, Paris

I was walking quickly towards our house on this cold and dark winter afternoon; all its lights looked strangely dimmed. Today was the planned power cut; with one of the coldest waves of the year hitting the city, the Co-op was going into a low energy regime to avoid soaring energy prices. Showering was not an option; domestic hot water was reserved for toddlers and elders. Frigid and disheartened, I headed to an early dinner. Entering the kitchen was like stepping into a forge; every stove was on, and dozens of people were cooking. On days like these, the kitchen wood stoves take over and make this space a delight. I was reluctant to start cooking among the happy mess of children running around and busy cooks trying to keep track of their pots. Luckily, Nora, who saw me dazed in the entrance, waved at me and offered me to join her family dinner as is our custom—sharing food is sharing heat. We sat in an earthen alcove of the dining area, where another family had already settled. Grateful for their thermal hospitality, I grabbed a bowl of soup. The heated walls and the intimate gathering warmed me up, and shortly after, I was off to bed. I curled under the thick blanket and surrendered to sleep.

I woke up on a bare mattress; the radiant heat had accumulated behind the thick felt curtains around my bed and made the blanket redundant halfway through the night. I pulled the curtains, and my senses were hastily awakened; bright sunlight poured in quickly, followed by a gust of cold air. I stepped out of the wooden deck, prepared a coffee, and proceeded to sip it by the window on the warm concrete slab that had been under the sun for a while. My room is quite small, at least twice smaller than my old one-bedroom apartment used to be. When I moved, it felt a bit suffocating at first. Now, I know I can move around the building to find the space and thermal comfort that suits my mood.

I headed to the showers, only to realize with disappointment that the ones on my floor were all taken. This often happens, and I usually go to the ones downstairs, but why not visit the bath today? In the warmer season, I gladly spend time in the summer bath: they open to the outside air and that's where I typically catch up with everyone. I more rarely go to the winter bath, which is more confined. Nested deep within the building's basement, where the thermal inertia is the strongest, the bath is shaped by stacked blocks of concrete and looks like a small cave retaining the heat emanating from the warm water. When I got there, I was glad to see Alix among a few older people, and I sat by their side. We talked about the building's recent drop in temperature and our favorite places to stay warm in this season, until the chatter of adolescents entering the bath interrupted our conversation. We concluded it was time to leave the space.

On our way out we noticed a number of people catching up on their housework after yesterday's power outage. The courtyard stack was filled with hanging clothes. We failed to avoid Madame Mollier who inevitably proceeded to recruit us to help her hang laundry, but managed to politely decline her lunch invitation. We headed to the solarium where the air behind the glass façade had been heated by the sun for hours. Here Alix and I joined the warm crowd that had gathered under the sun of this winter afternoon.

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APPENDIX

Figure 41. *Concrete model, in process of transformation*

Figure 42. *Material samples: concrete, rammed earth, felt, wood*

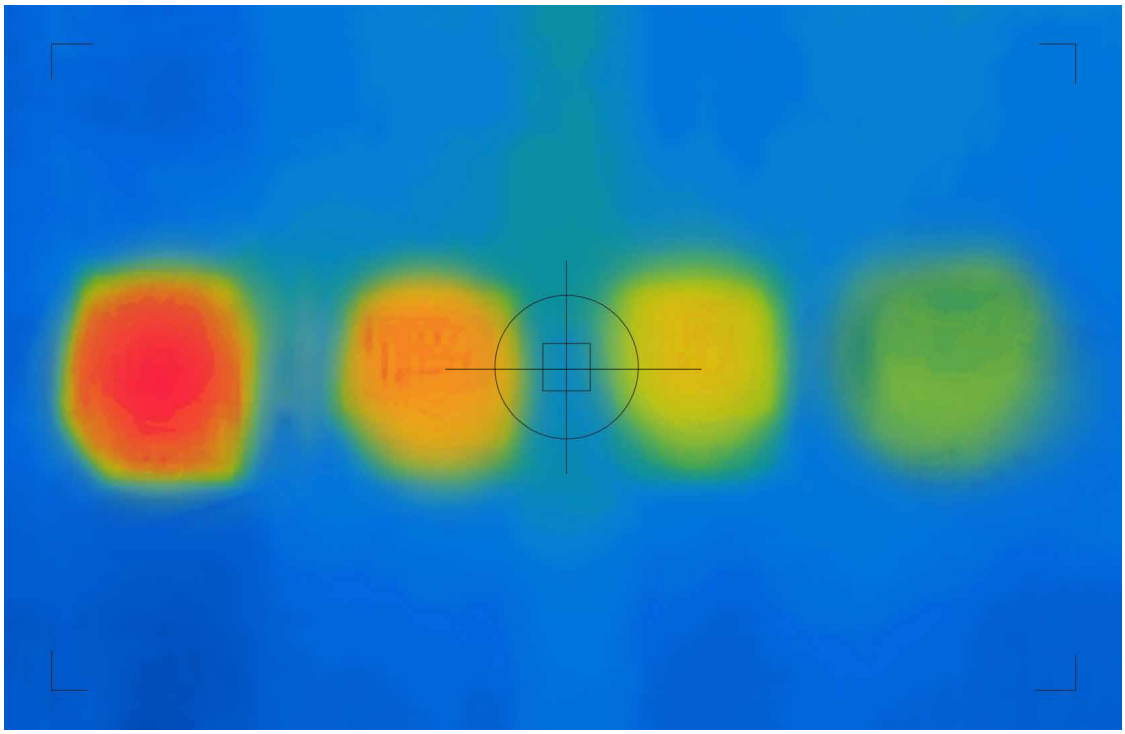


Figure 43. *Thermal image showing materials' varying thermal emissivity*

Figure 44. *Concrete model: the Modern shell*

Figure 45. *Concrete model: the Modern shell*

Figure 46. *Concrete model: the Modern shell, hacked, ©Andy Ryan*

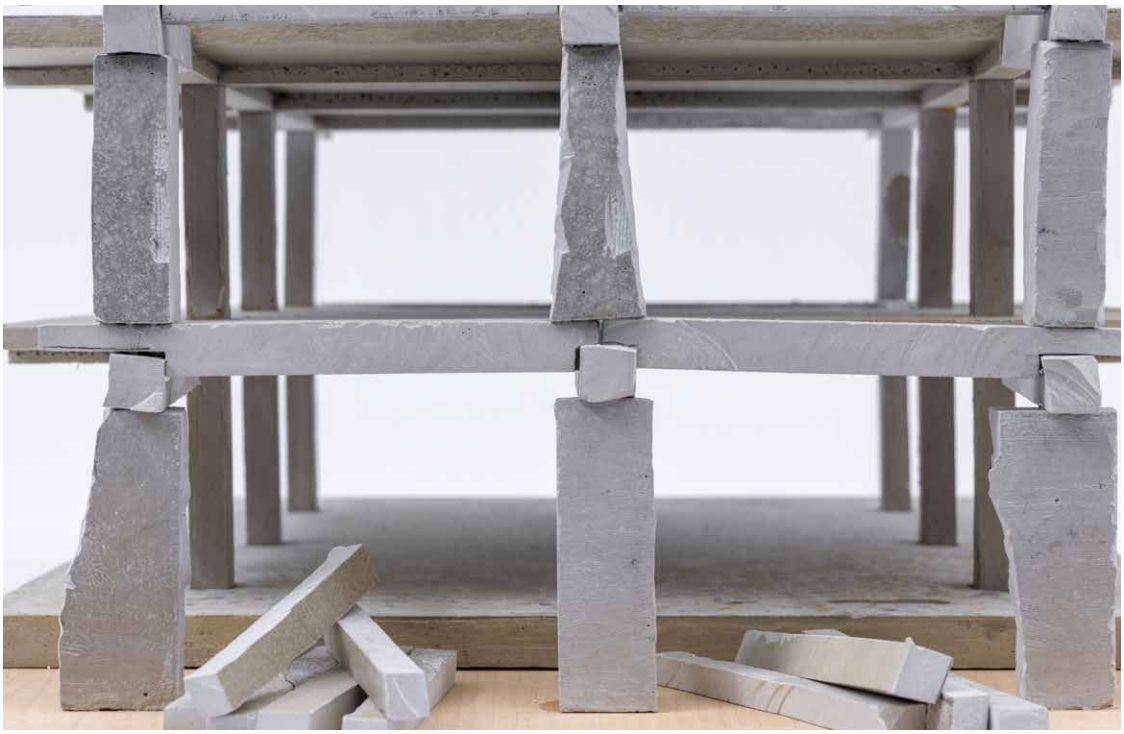


Figure 47. *Concrete model: the Modern shell, hacked, ©Andy Ryan*

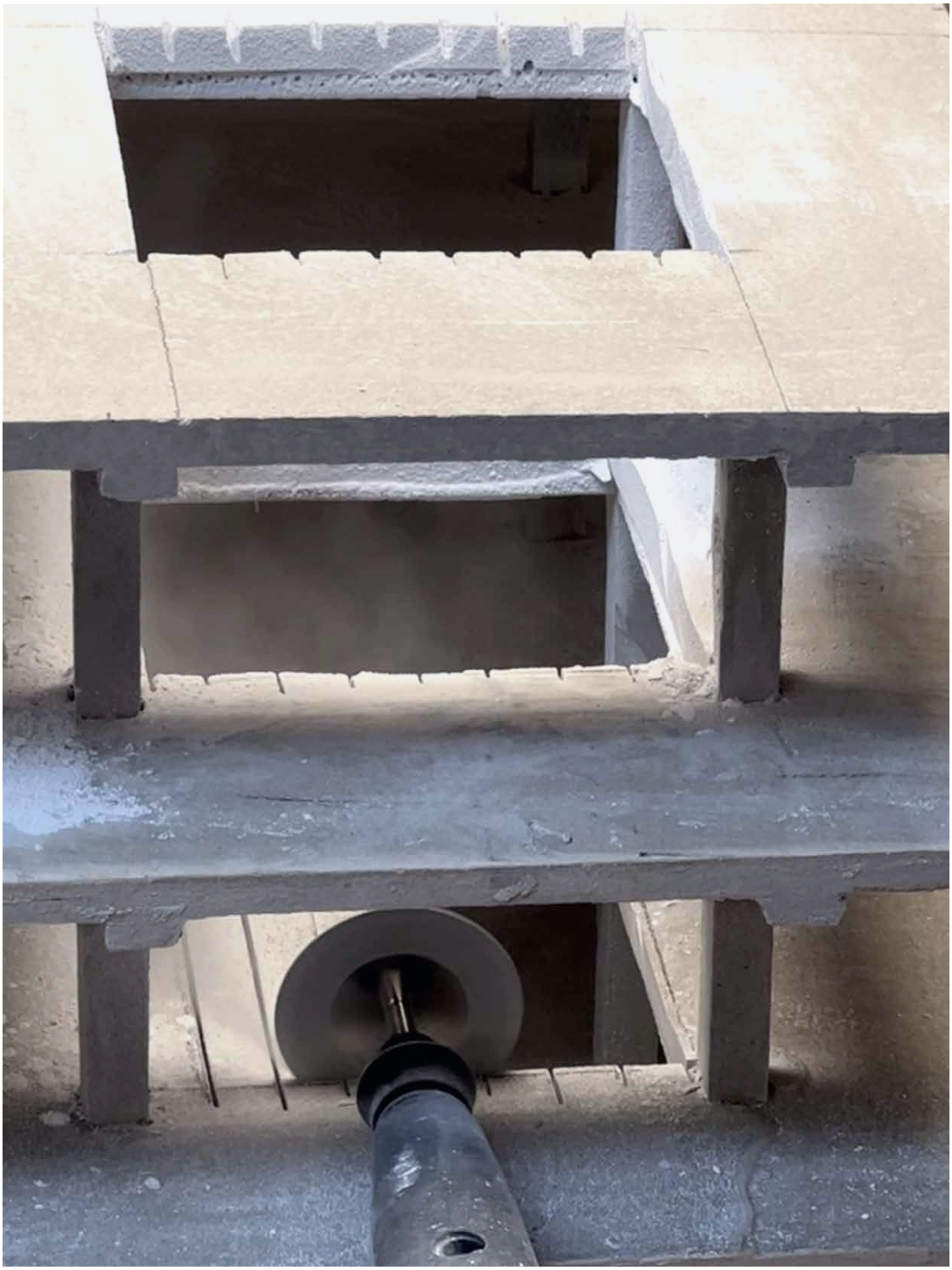


Figure 48. *Concrete model: cutting the slabs*

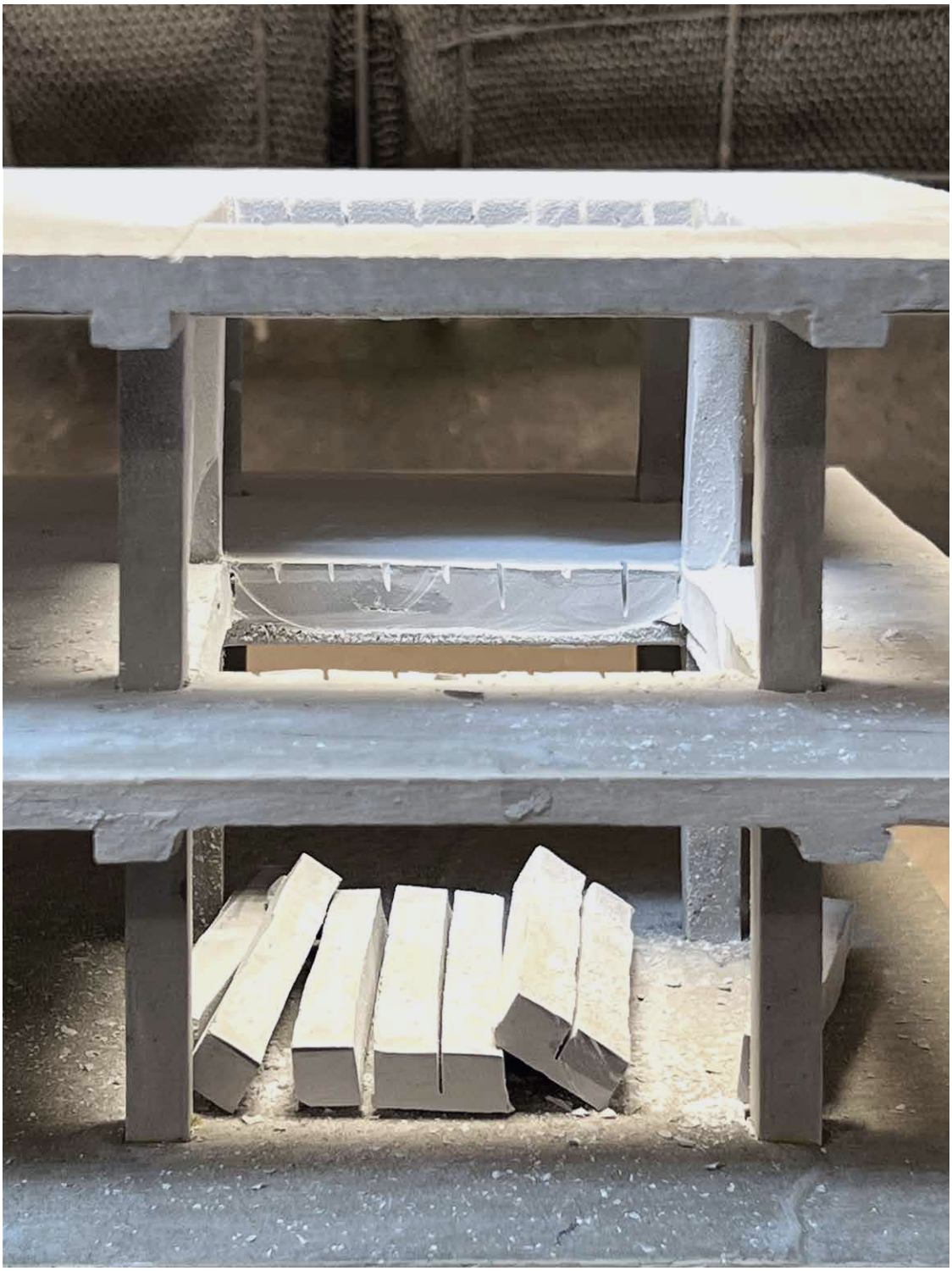


Figure 49. *Concrete model: cutting the slabs*

Figure 50. *Entrance lobby*

Figure 51. *Workshop*

Figure 52. *Summer bath*

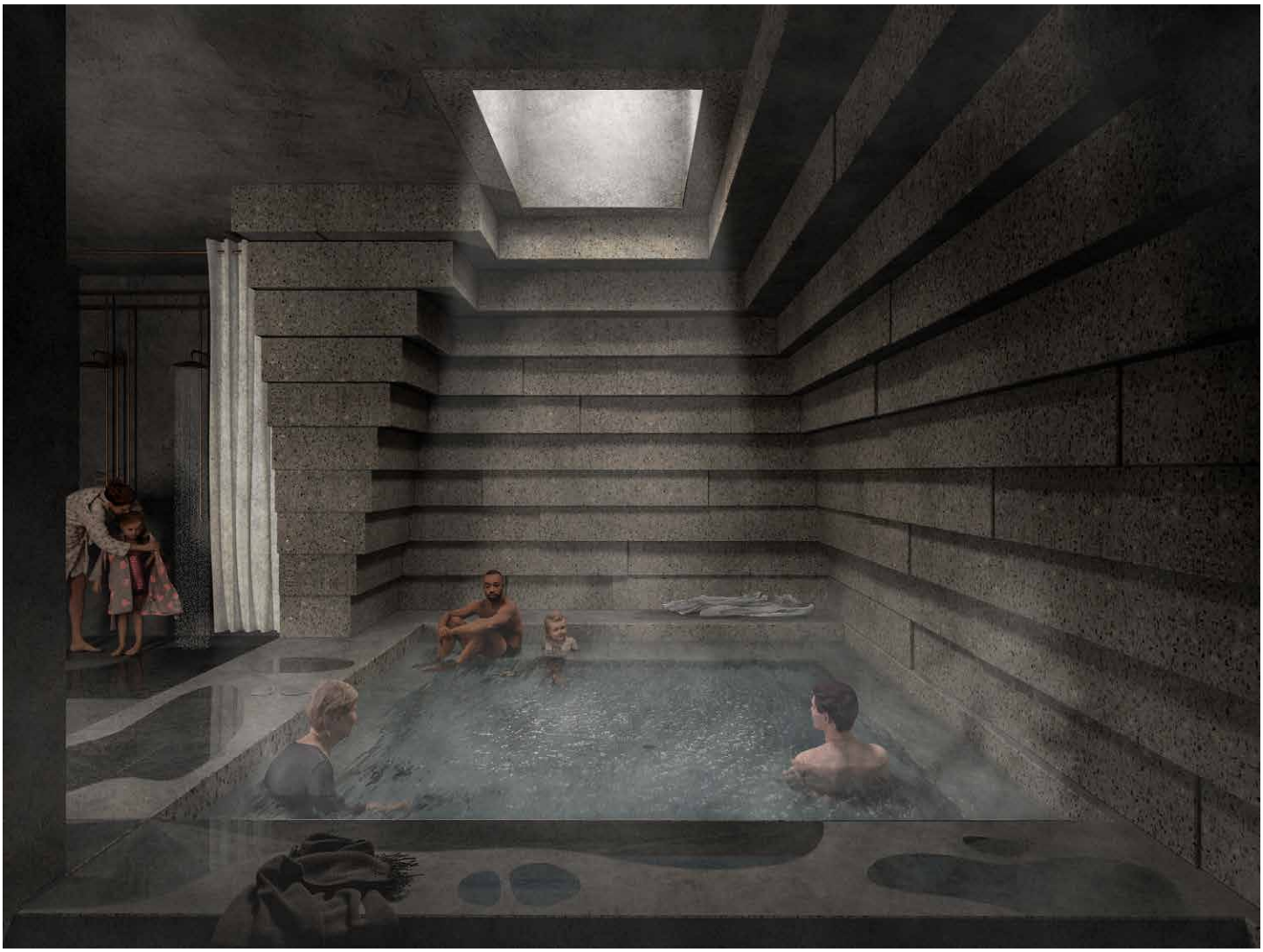


Figure 53. *Winter bath*

Figure 54. *Peripheral bedroom*

Figure 55. *Courtyard bedroom*

Figure 56. *Library*

Figure 57. *Solarium*

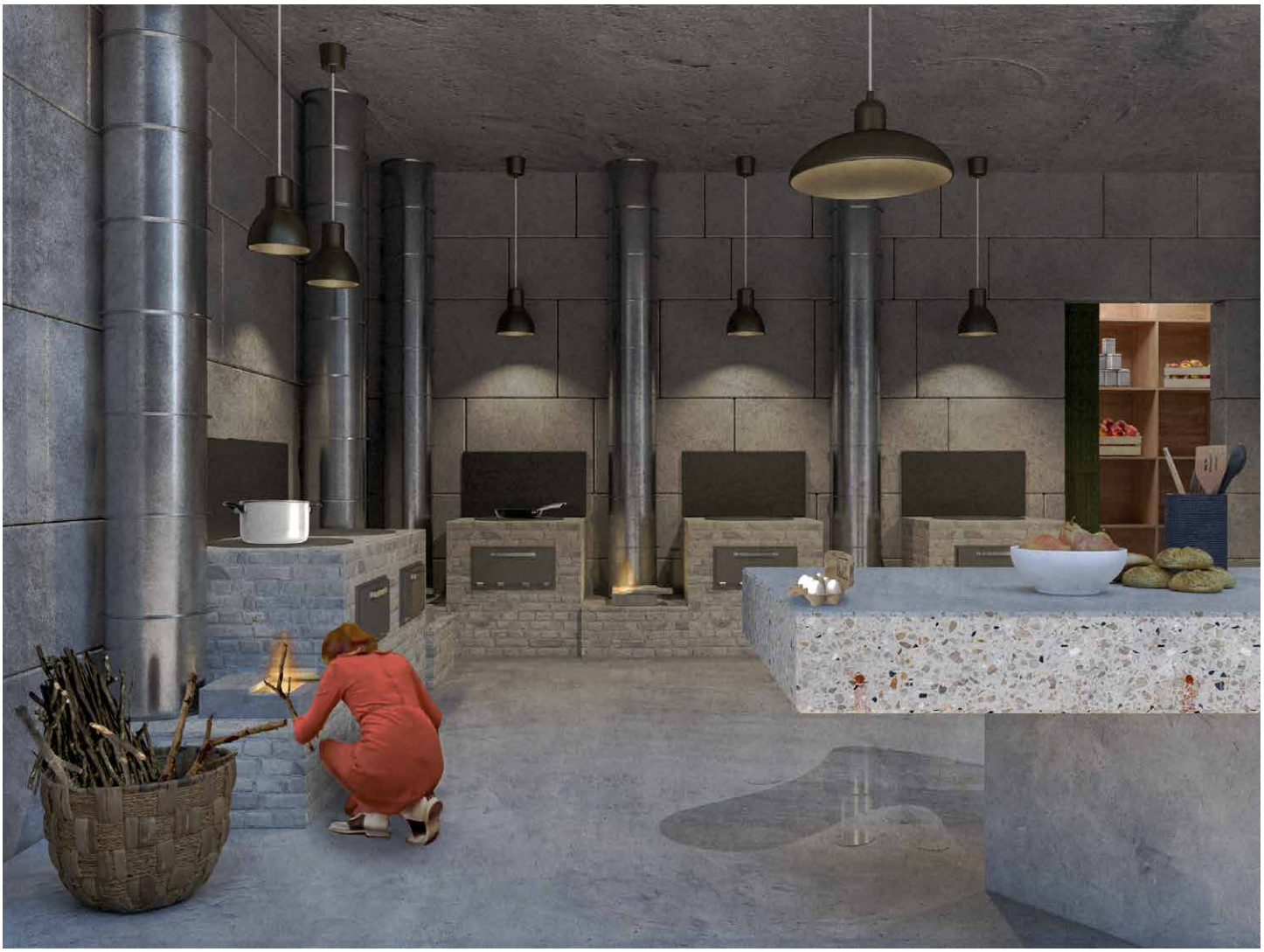


Figure 58. *Wood rocket stove*

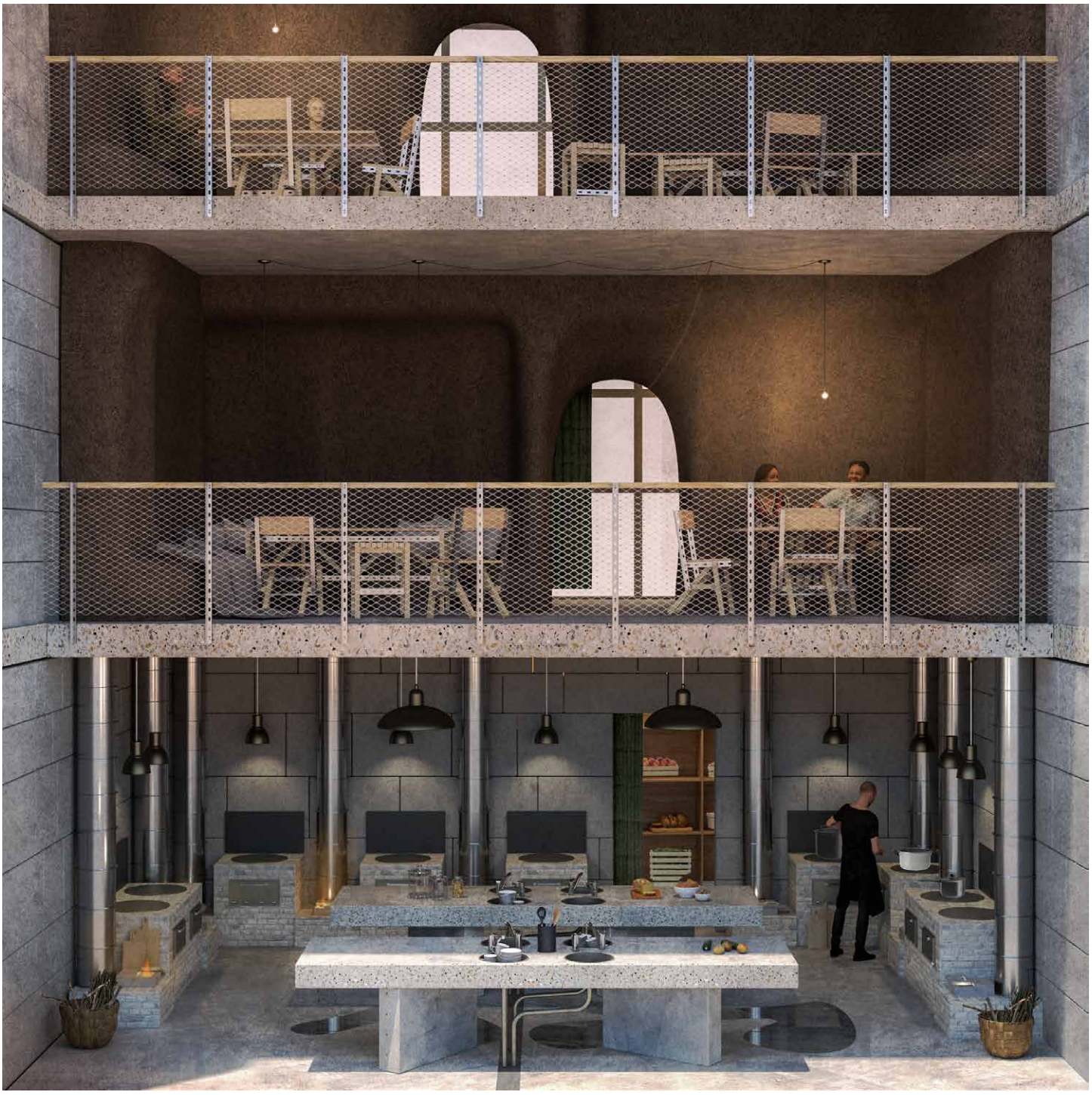


Figure 59. *Kitchen by day*

Figure 60. *Dining alcove*

Figure 61. *Kitchen by night*

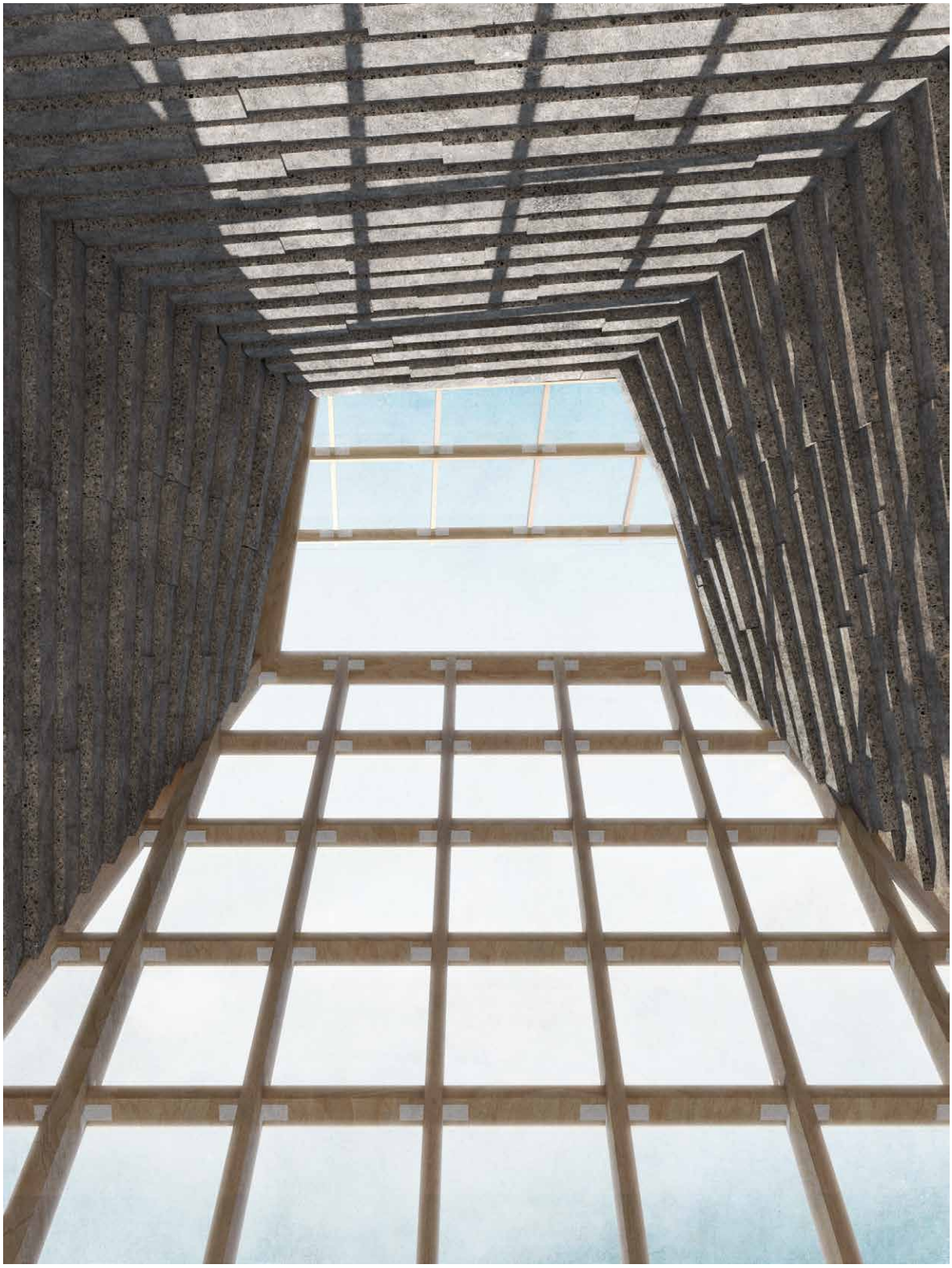


Figure 62. *Solar chimney*

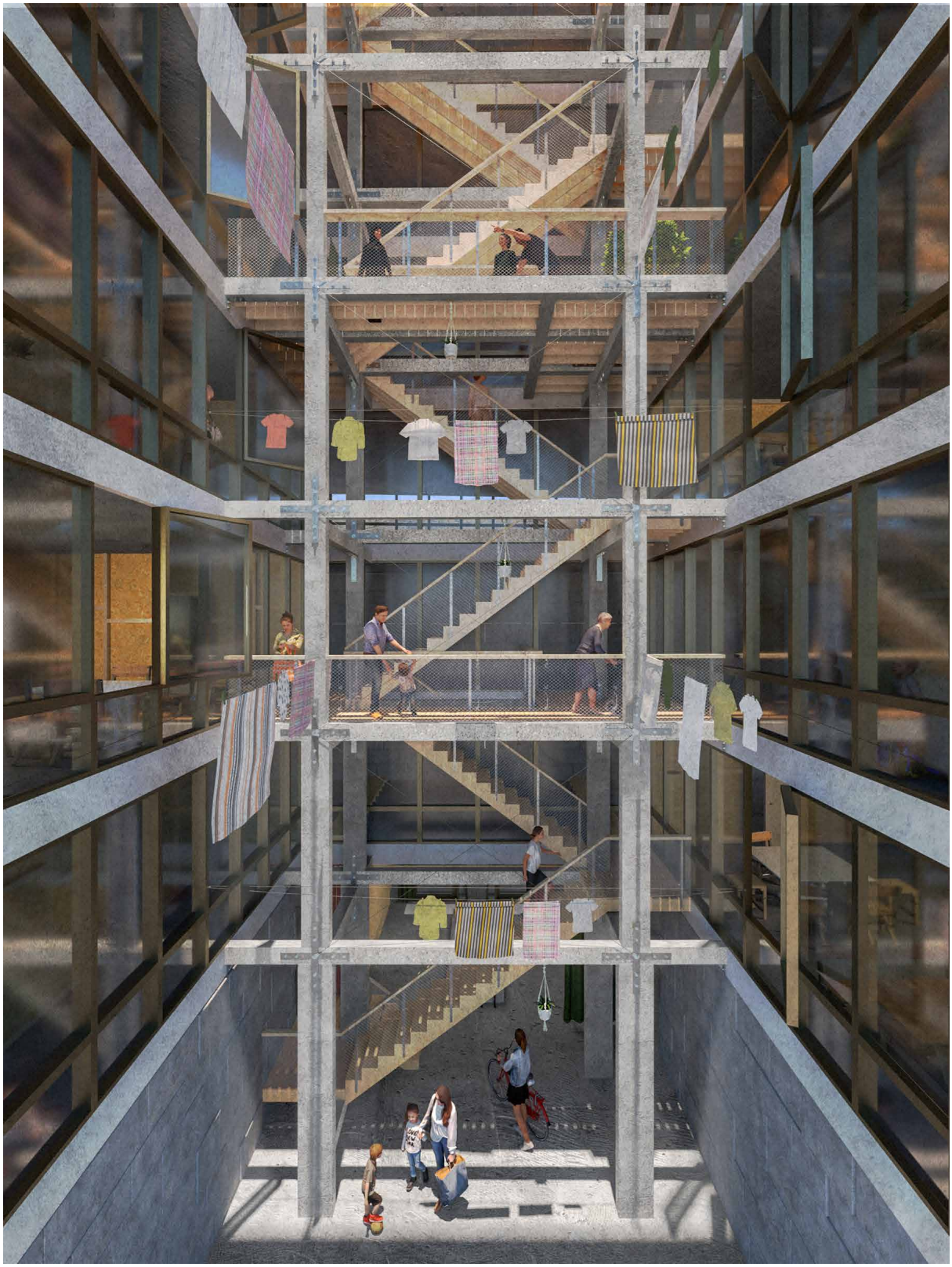


Figure 63. *Atrium*

Figure 64. *Tram stop*

Figure 65. *Balconies*

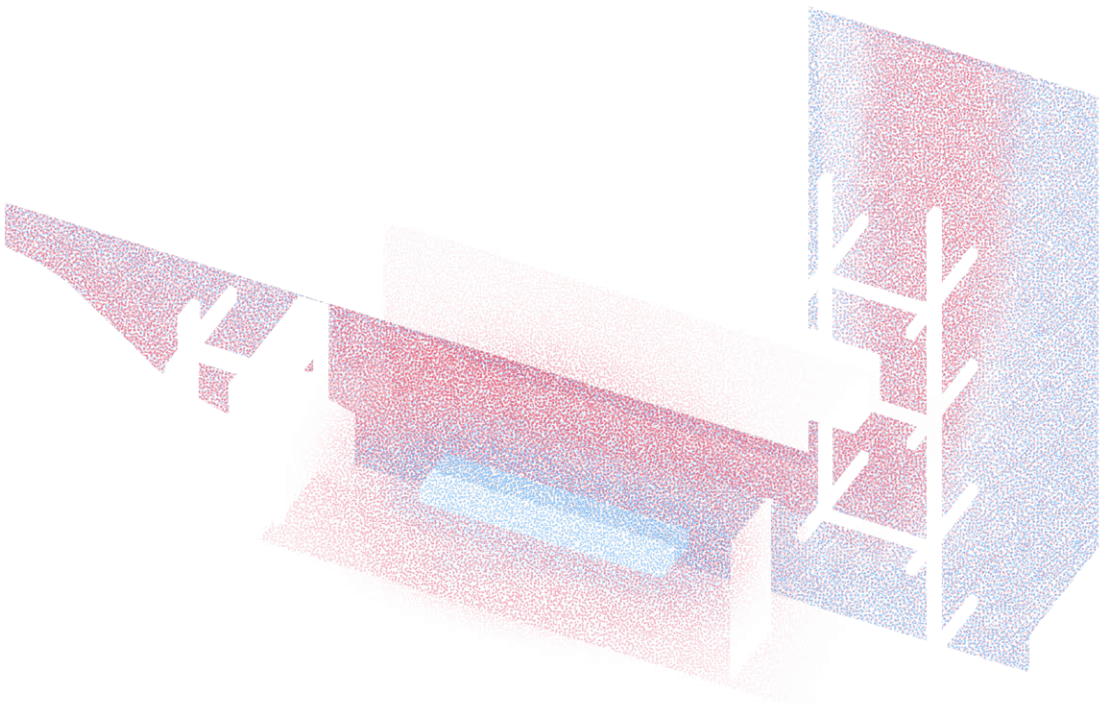


Figure 66. *Entrance lobby*

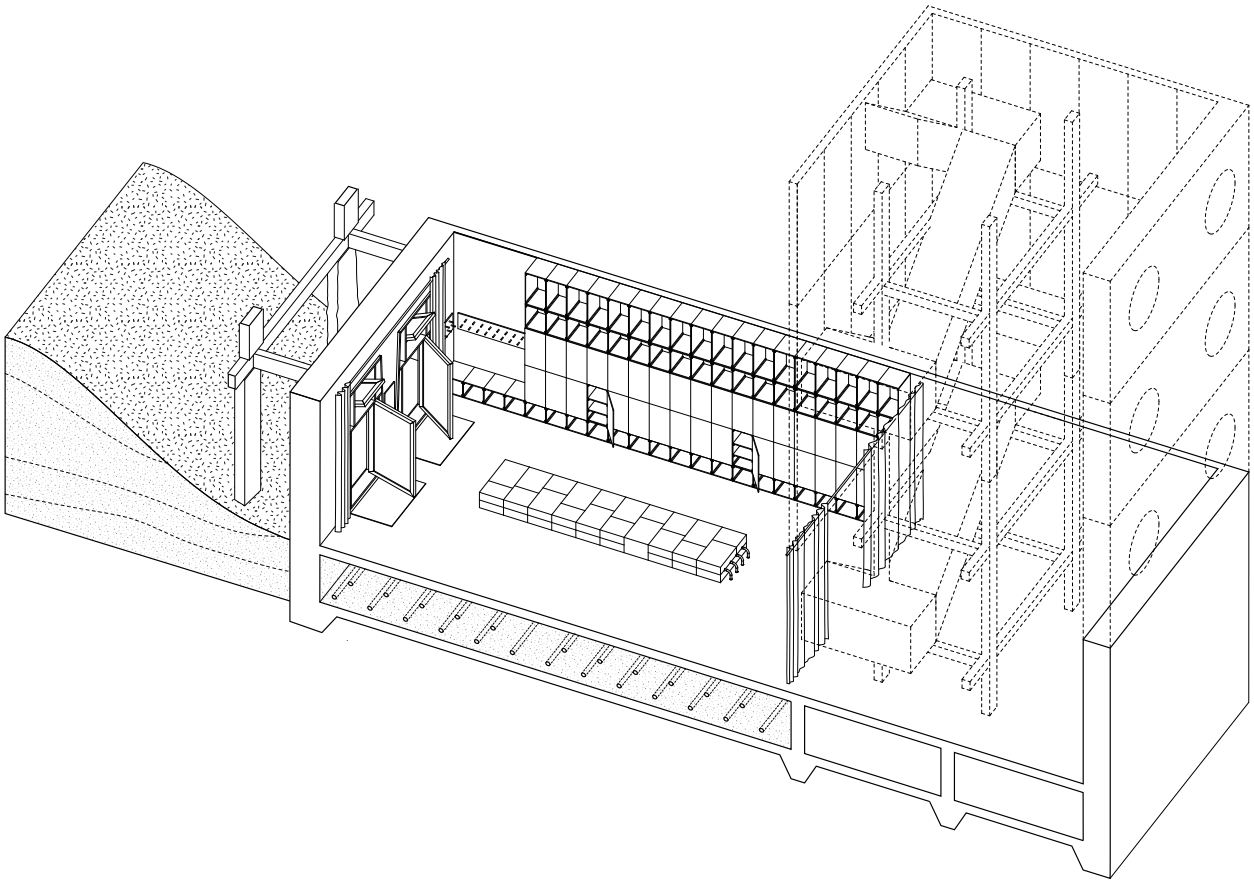


Figure 67. *Entrance lobby*

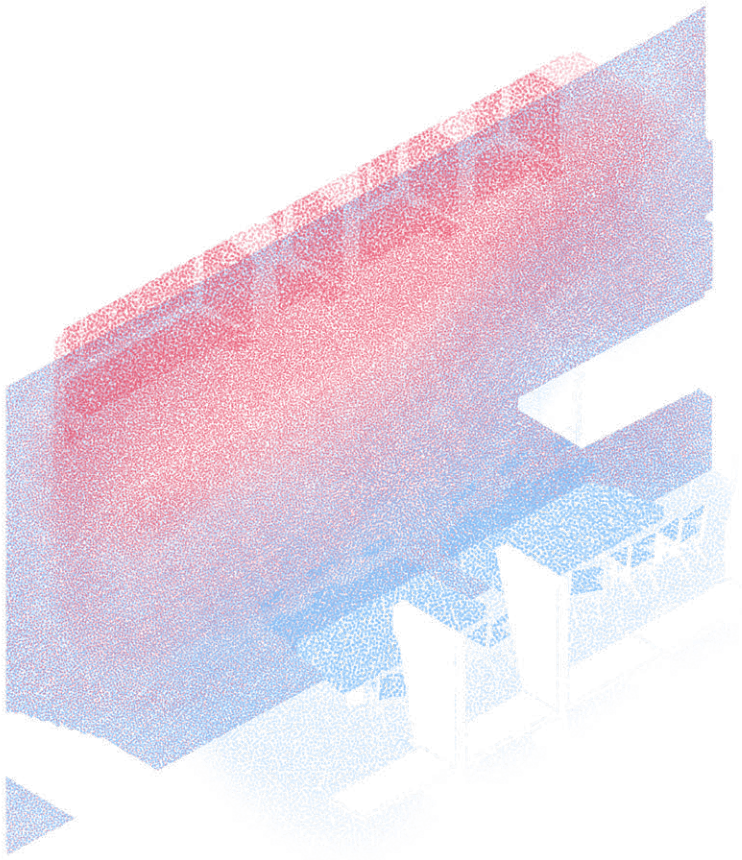


Figure 68. *Library*

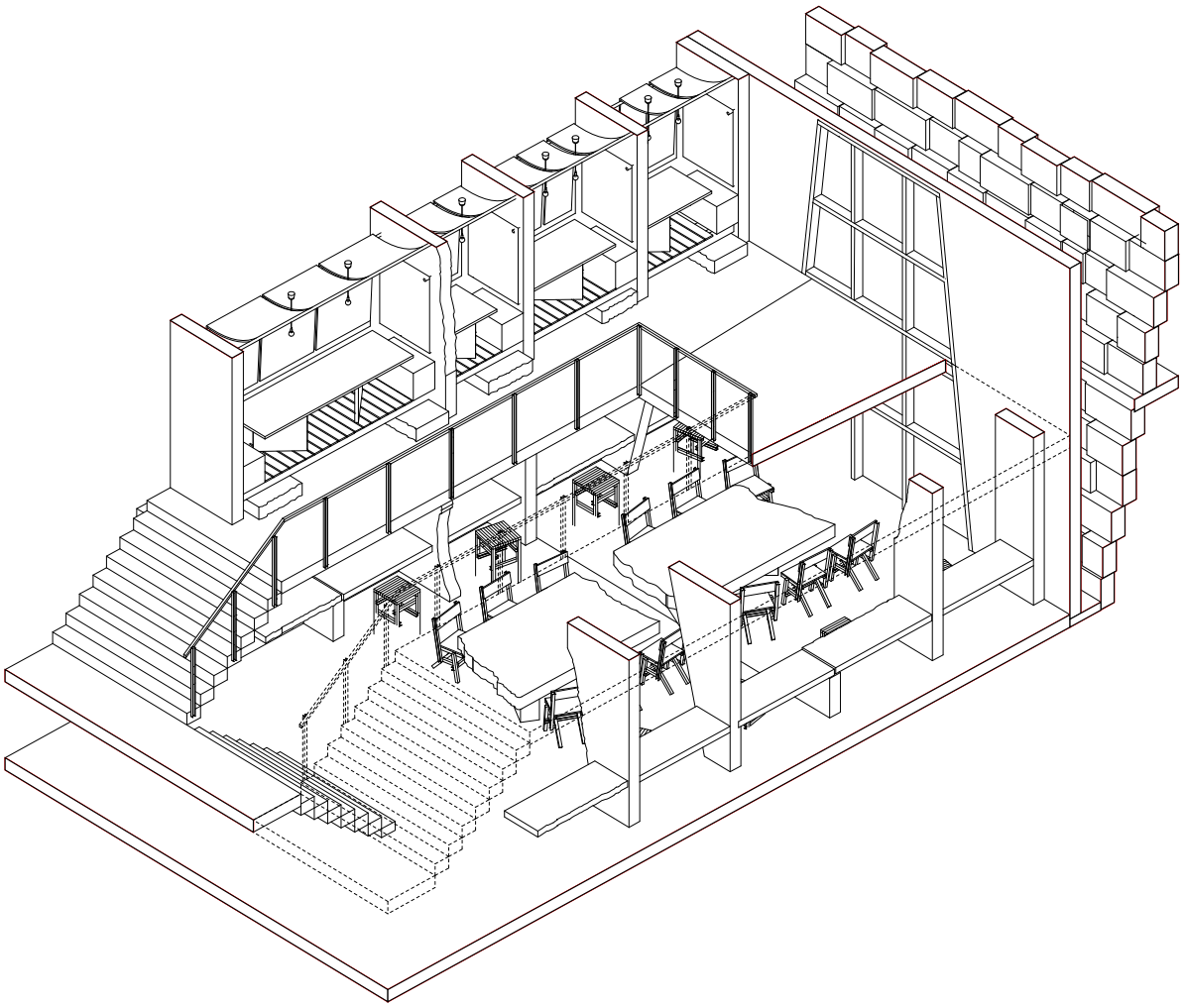


Figure 69. *Library*

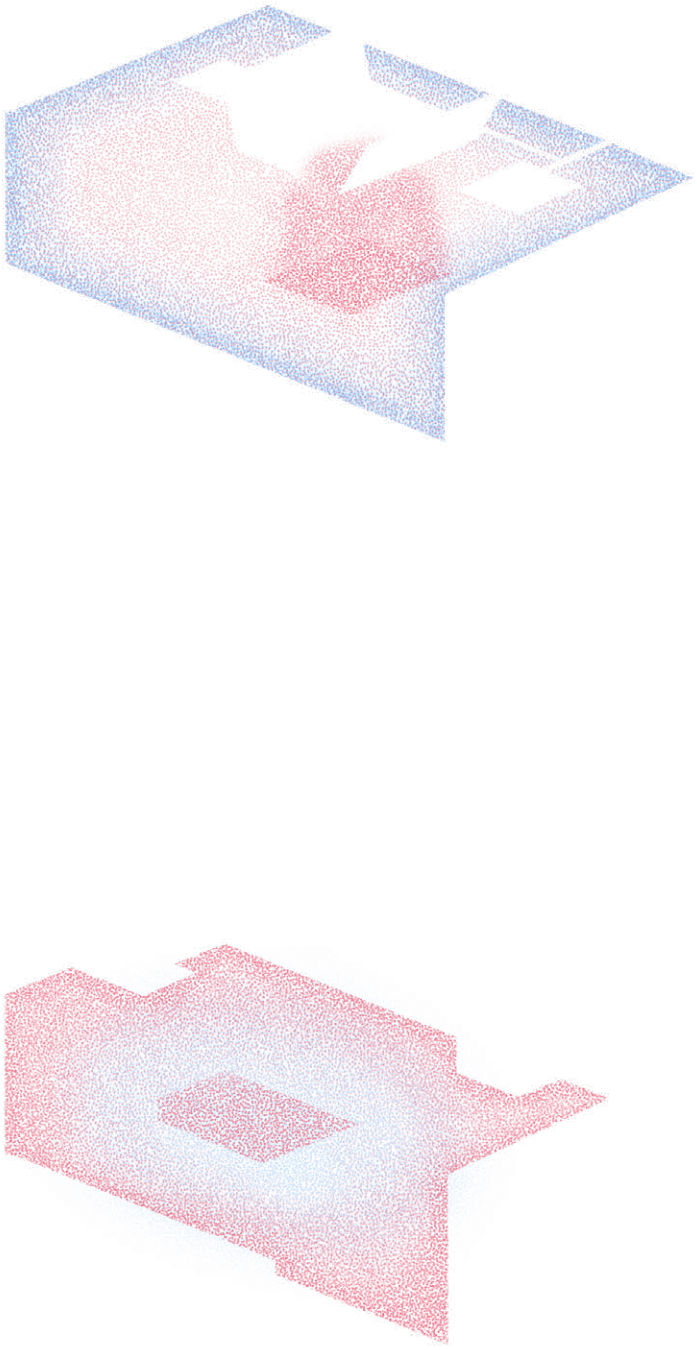


Figure 70. *Summer and winter baths*

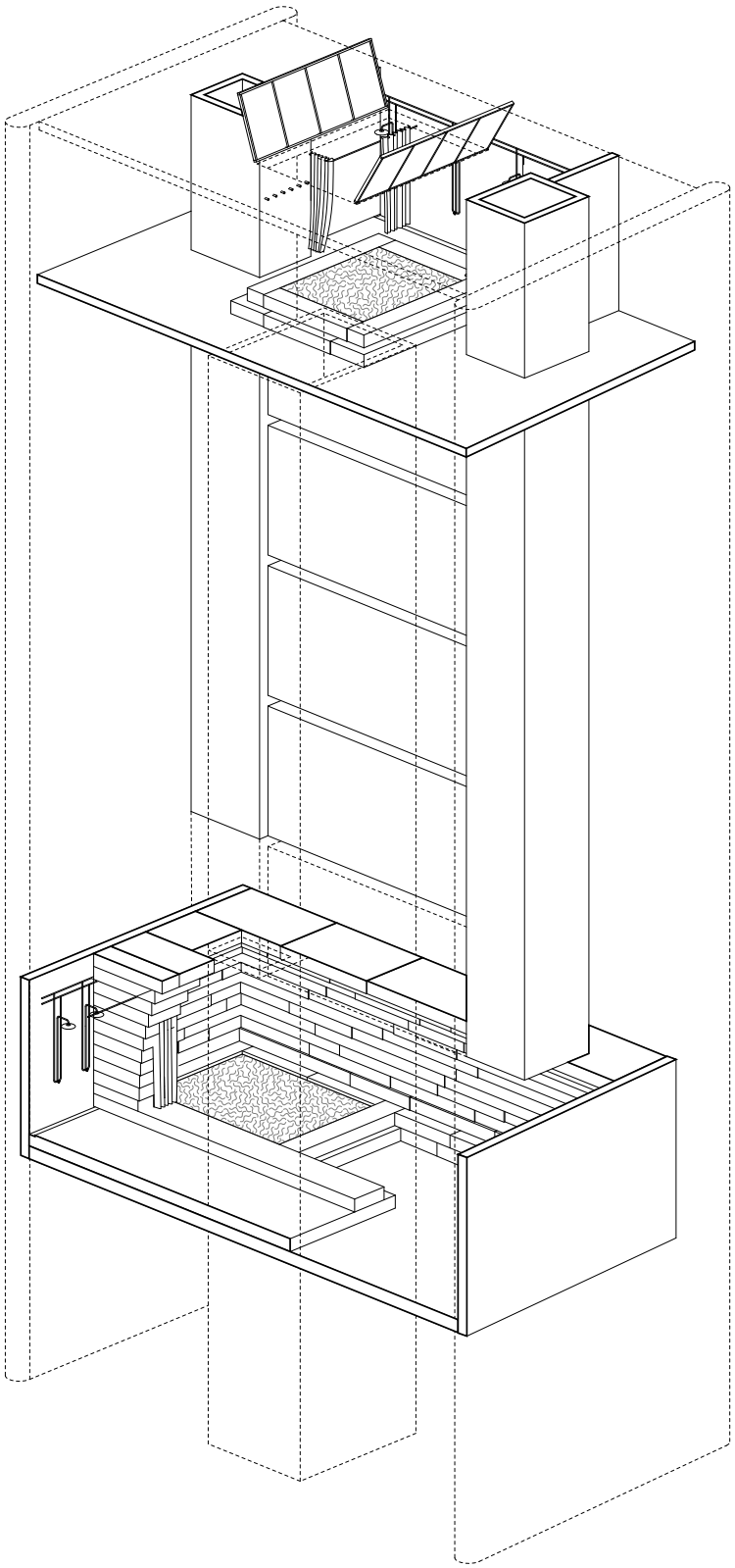


Figure 71. *Summer and winter baths*

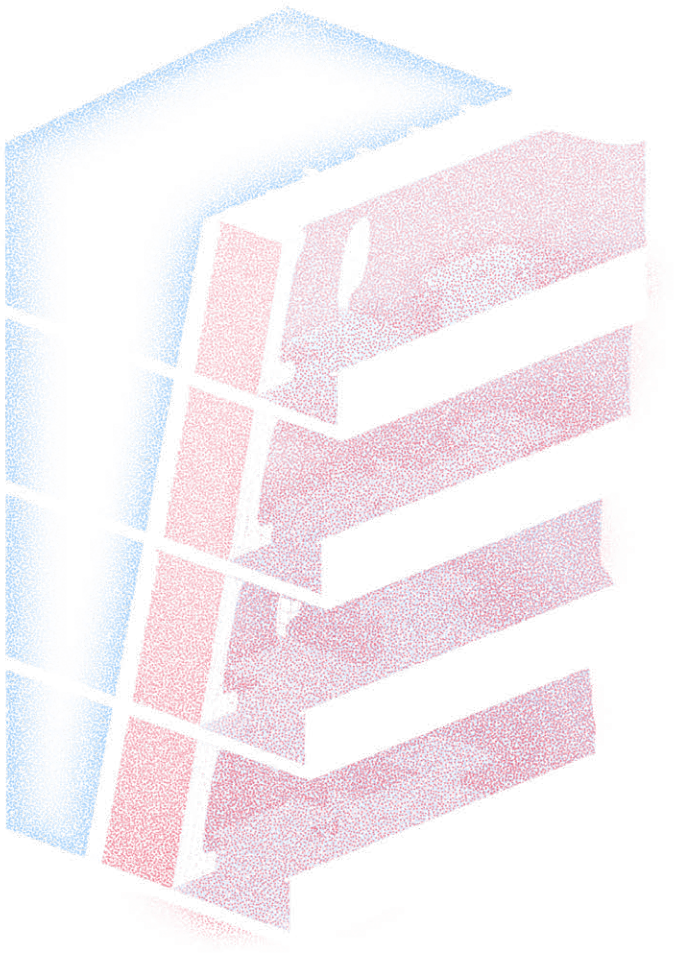


Figure 72. *Kitchen and dining*

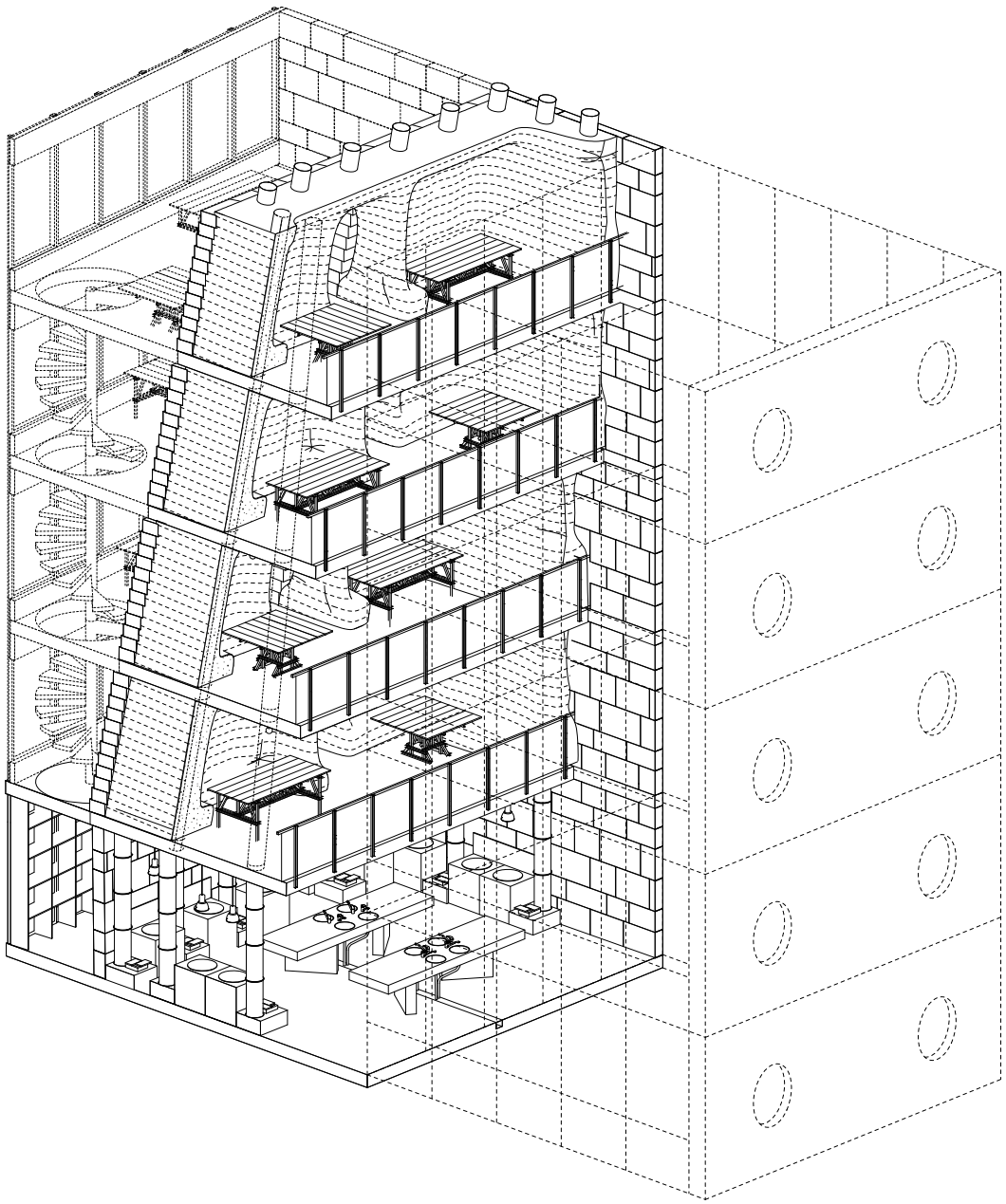


Figure 73. *Kitchen and dining*

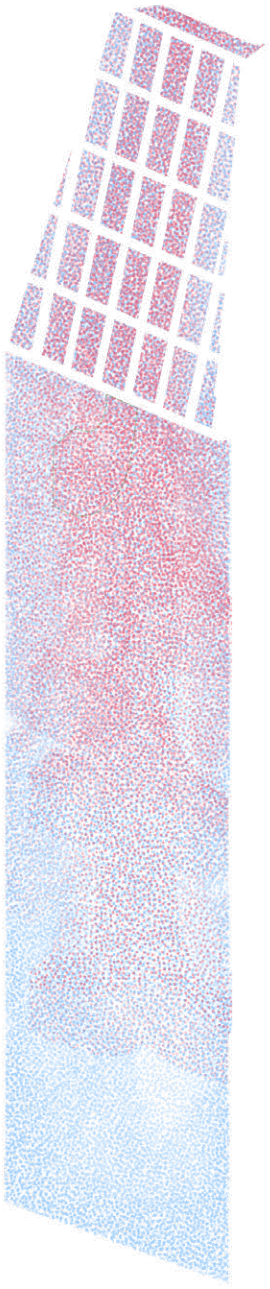


Figure 74. *Atrium and solar chimney*

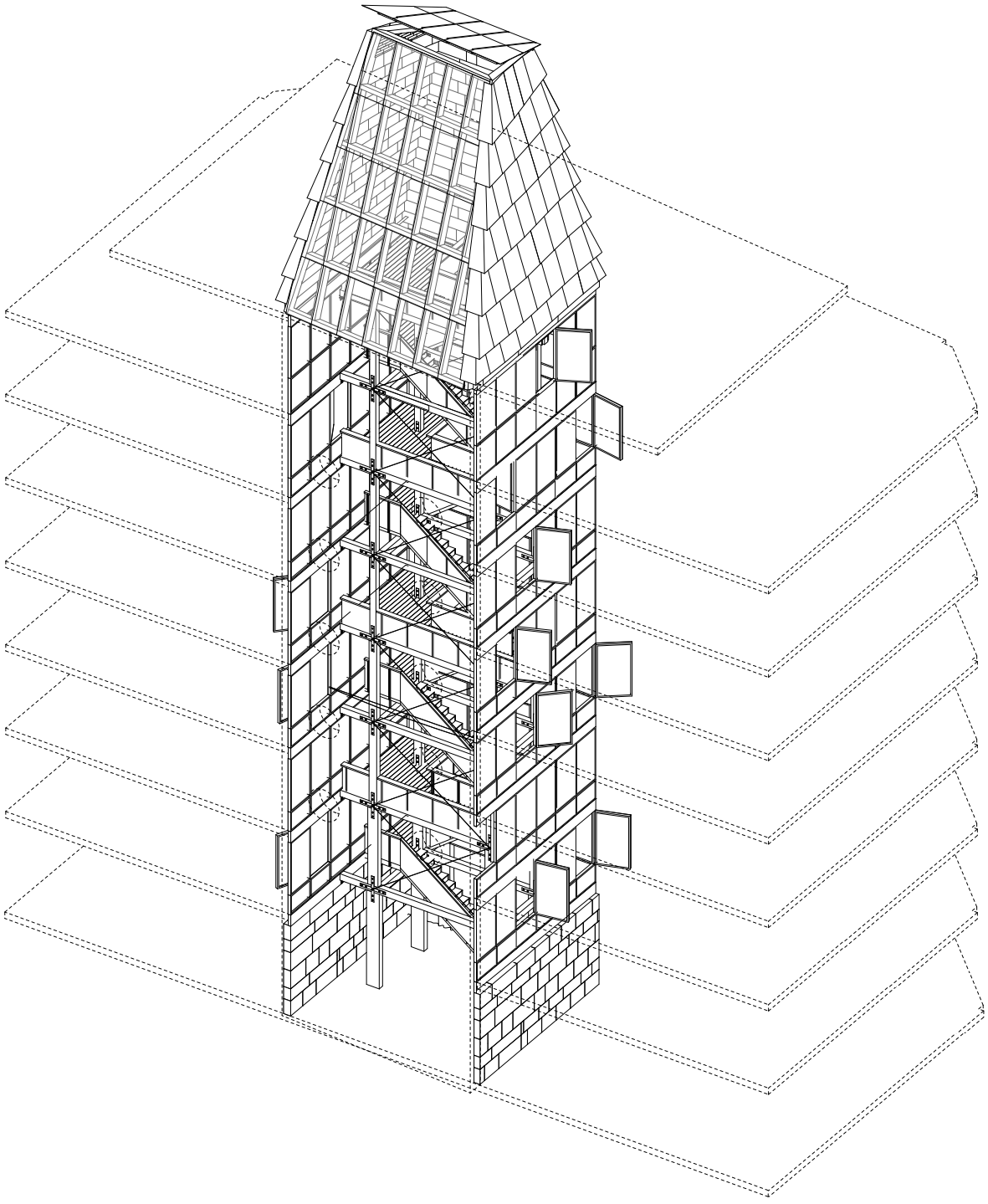


Figure 75. *Atrium and solar chimney*

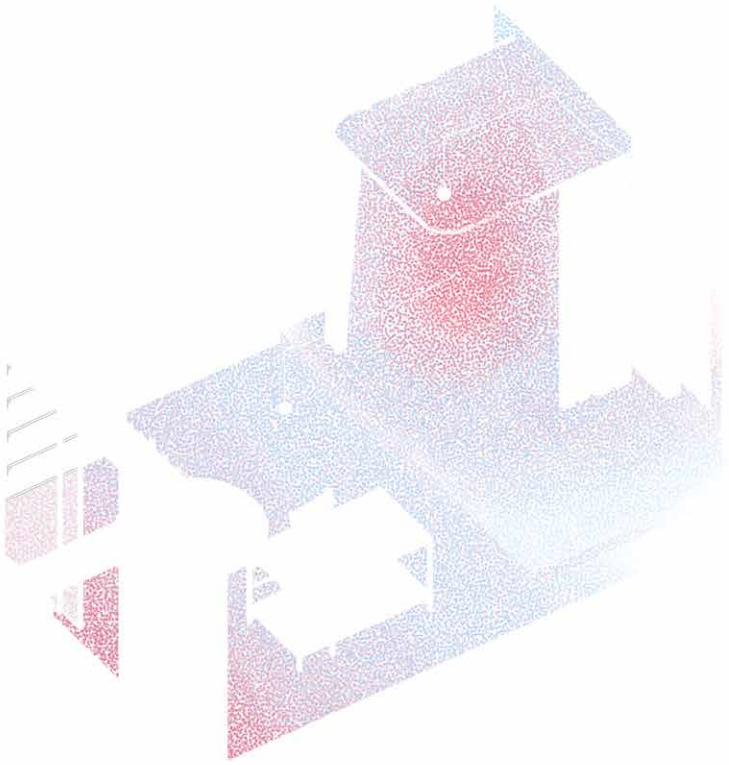


Figure 76. *Peripheral bedroom*

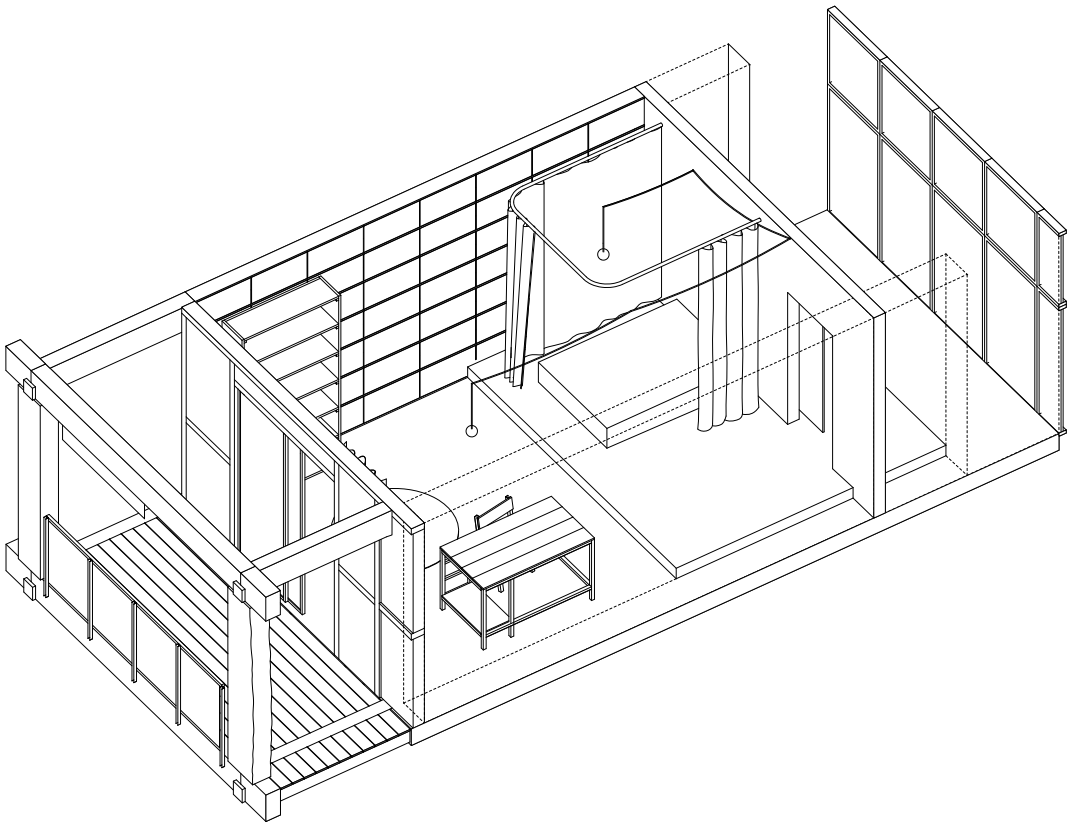


Figure 77. *Peripheral bedroom*

Figure 78. *Wood rocket stov3*

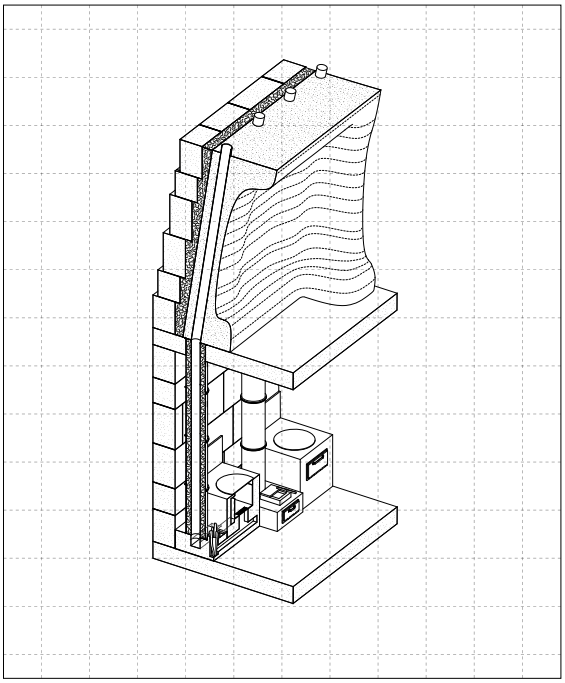
Figure 79. *Radiant bench*

Figure 80. *Solar chimney*

Figure 81. *Felt nook*

WOOD ROCKET STOVE
Thermal Device n°1

TECHNICAL APPENDIX



Thermal Collective Cooperative
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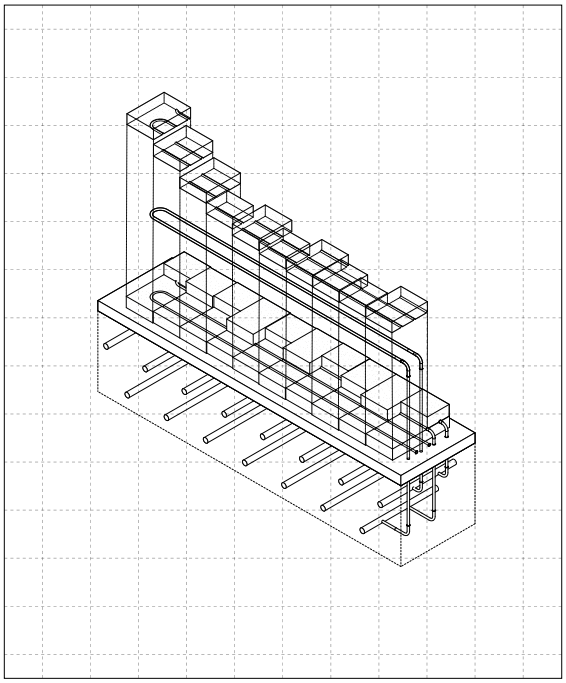
December 2029

RADIANT BENCH
Thermal Device n°2

TECHNICAL APPENDIX



Thermal Collective Cooperative
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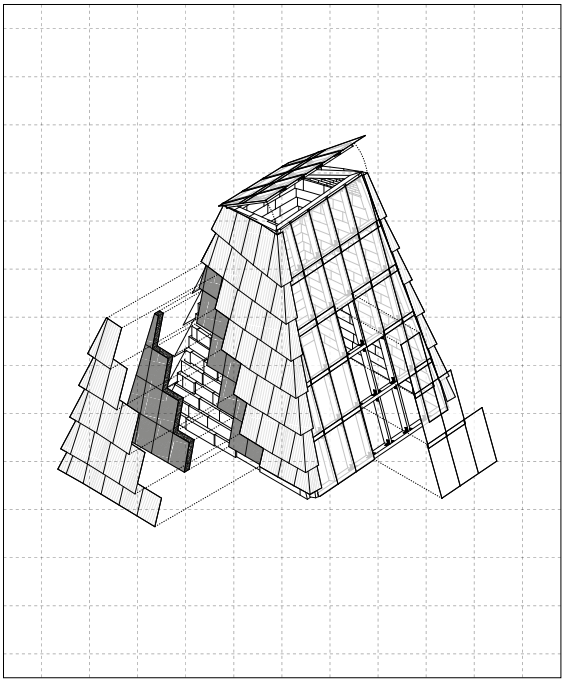
SOLAR CHIMNEY
Thermal Device n°3

TECHNICAL APPENDIX



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FELT NOOK
Thermal Device n°4

TECHNICAL APPENDIX

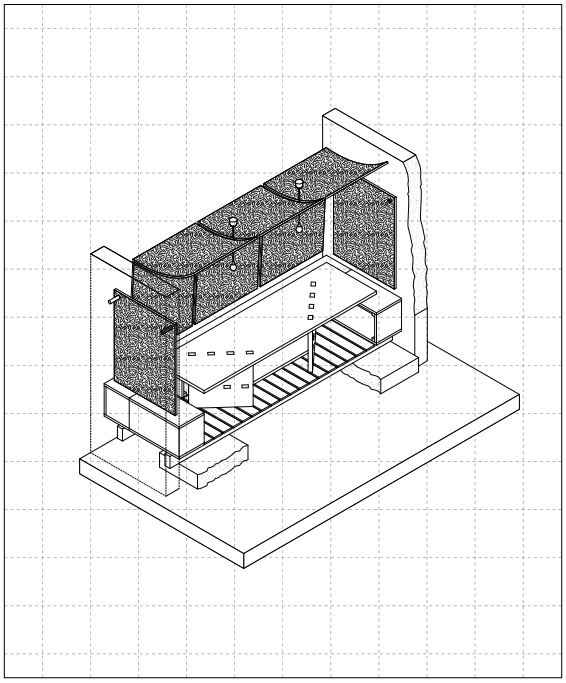

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Figure 82. *Desk*

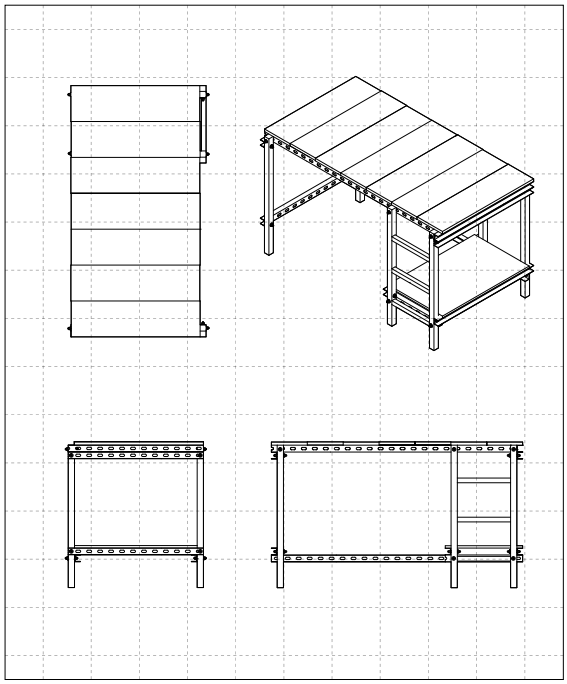
Figure 83. *Summer chair*

Figure 84. *Winter chair*

Figure 85. *Bunk bed*

DESK
Thermal Furniture n°3

TECHNICAL APPENDIX



Thermal Collective Cooperative
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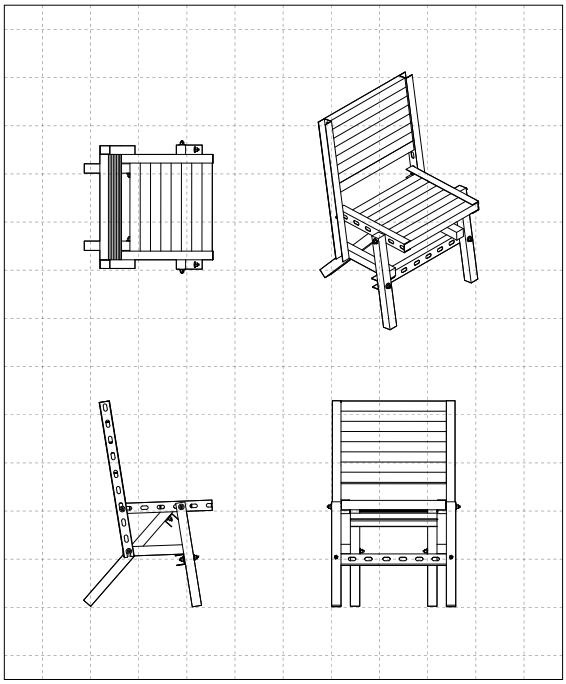
CHAIR (SUMMER)
Thermal Furniture n°3

TECHNICAL APPENDIX



Thermal Collective Cooperative
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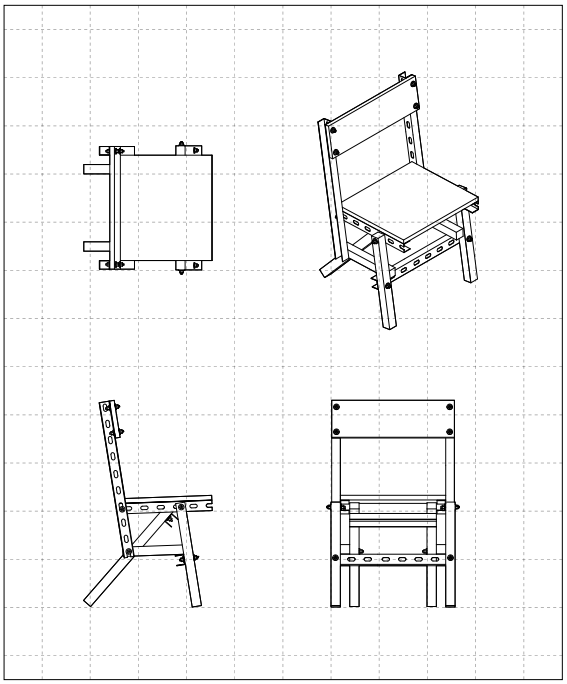
CHAIR (WINTER)
Thermal Furniture n°3

TECHNICAL APPENDIX



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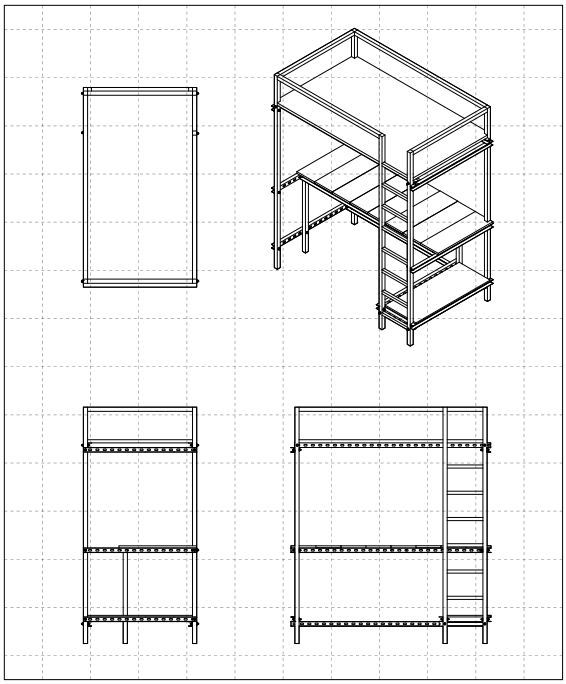
DESK
Thermal Furniture n°3

TECHNICAL APPENDIX



Thermal Collective Cooperative
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Figure 86. *Bench*

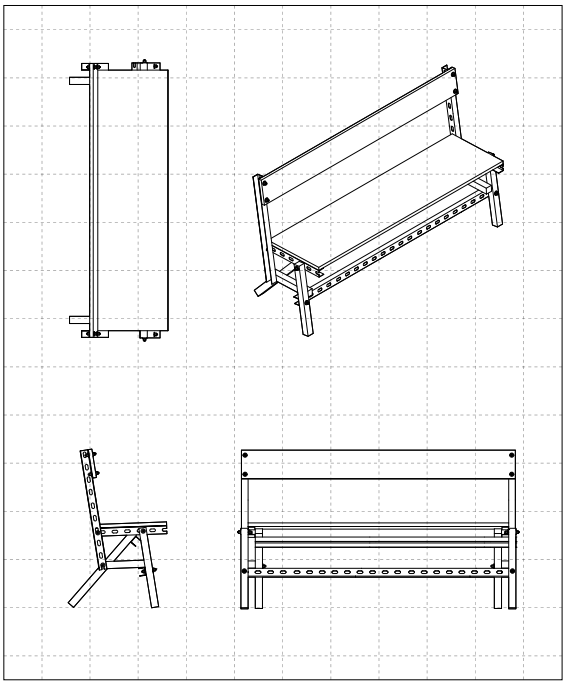
Figure 87. *Library table*

Figure 88. *Dining table*

Figure 89. *Coffee table*

BENCH
Thermal Furniture n°3

TECHNICAL APPENDIX



Thermal Collective Cooperative
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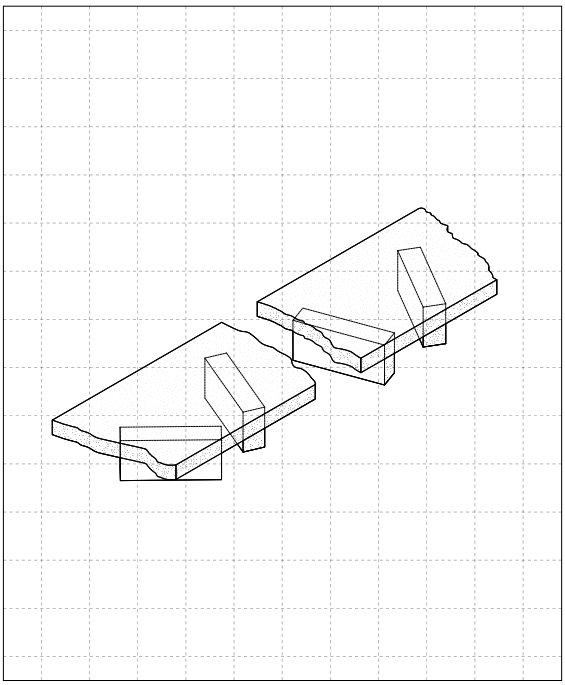
LIBRARY TABLE
Thermal Device n°5

TECHNICAL APPENDIX



Thermal Collective Cooperative
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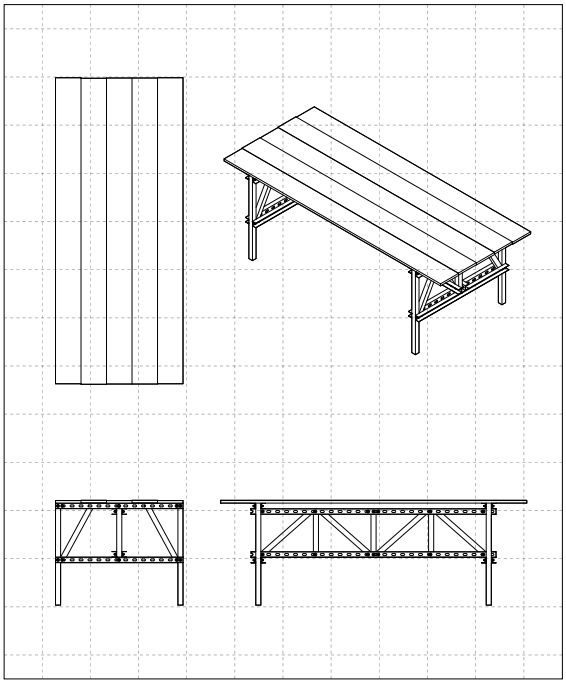
DINING TABLE
Thermal Furniture n°3

TECHNICAL APPENDIX



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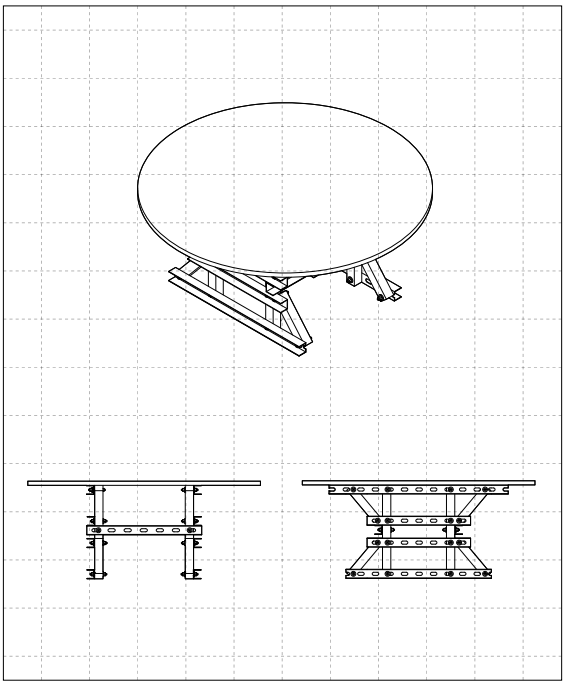
COFFEE TABLE
Thermal Furniture n°3

TECHNICAL APPENDIX



Thermal Collective Cooperative
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Figure 90. *Concrete blocks*

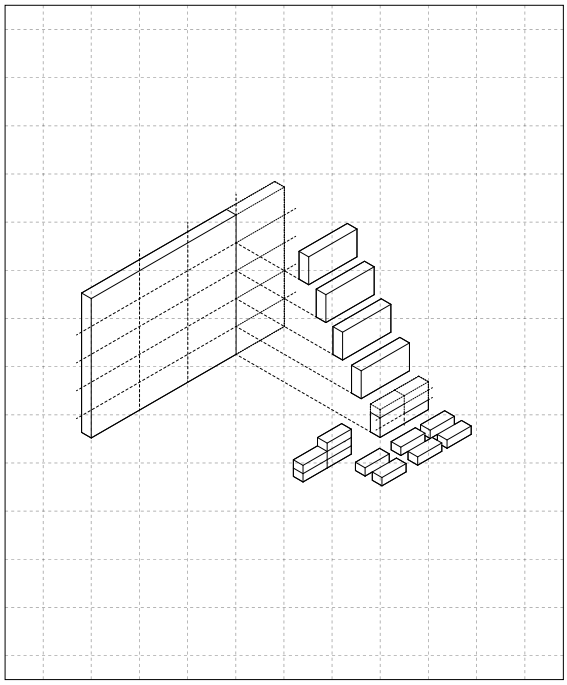
Figure 91. *Concrete beams*

Figure 92. *Earth blocks*

Figure 93. *Circular windows*

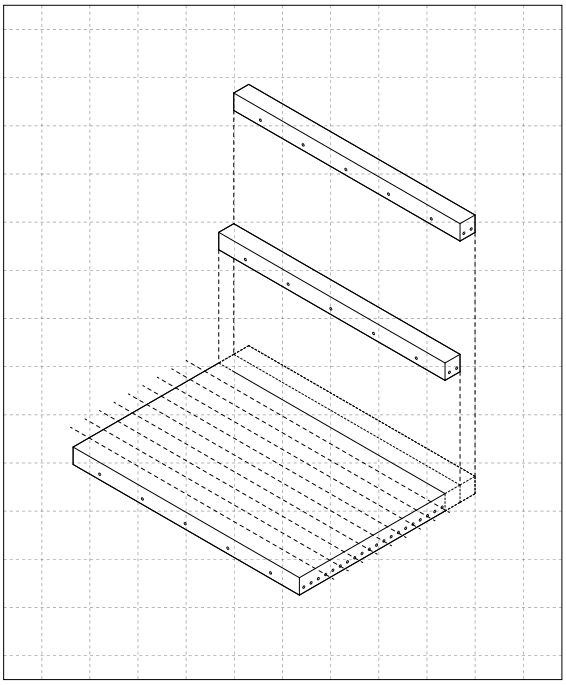
CONCRETE BLOCKS
Material Transformation n°2

TECHNICAL APPENDIX



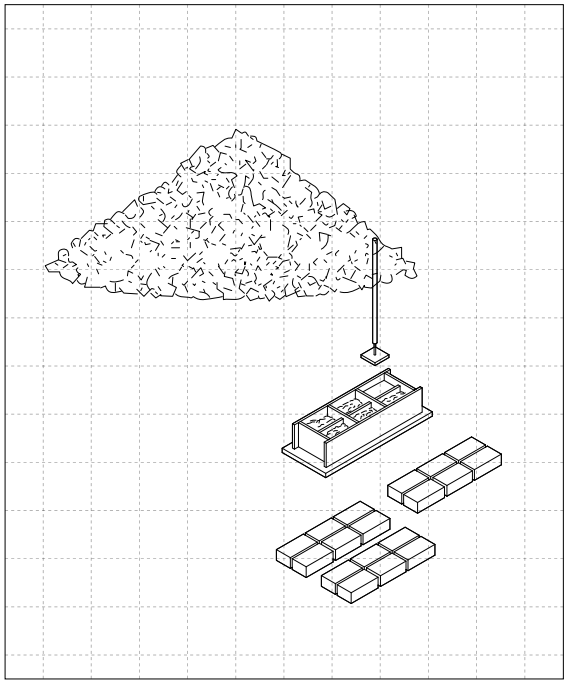
CONCRETE BEAMS
Material Transformation n°1

TECHNICAL APPENDIX



EARTH BLOCKS
Material Transformation n°4

TECHNICAL APPENDIX



CIRCULAR WINDOWS
Material Transformation n°3

TECHNICAL APPENDIX

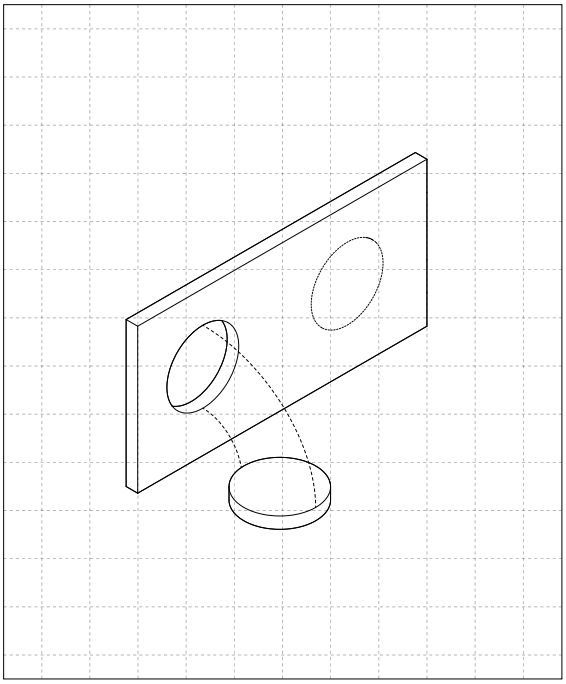


Figure 94. *Drop ceiling*

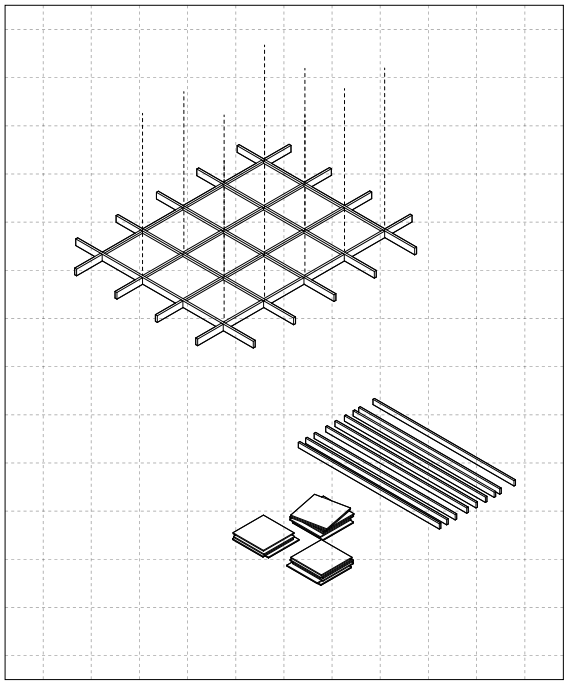
Figure 95. *Partition panels*

Figure 96. *Window frames*

Figure 97. *Concrete blocks*

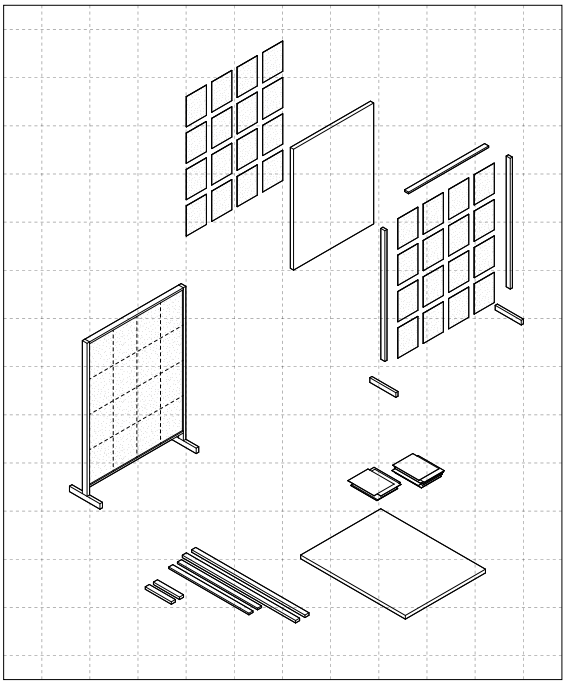
DROP CEILING
Material Transformation n°7

TECHNICAL APPENDIX



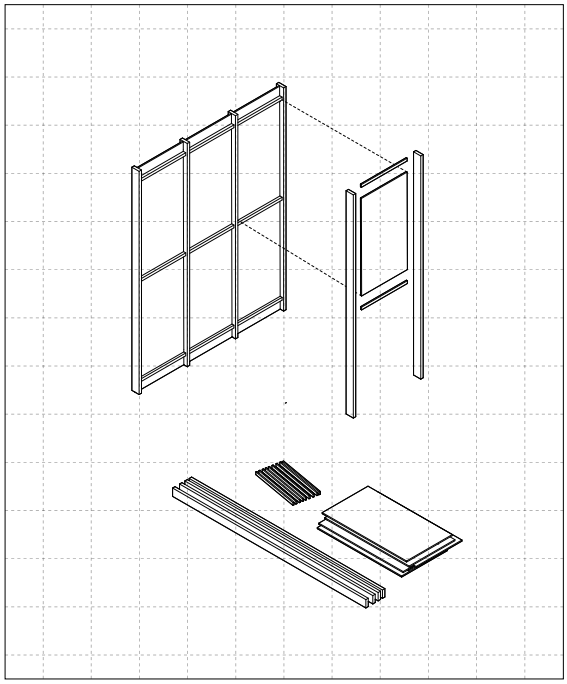
PARTITION PANELS
Material Transformation n°6

TECHNICAL APPENDIX



WINDOW FRAME
Material Transformation n°5

TECHNICAL APPENDIX



CONCRETE BLOCKS
Material Transformation n°2

TECHNICAL APPENDIX

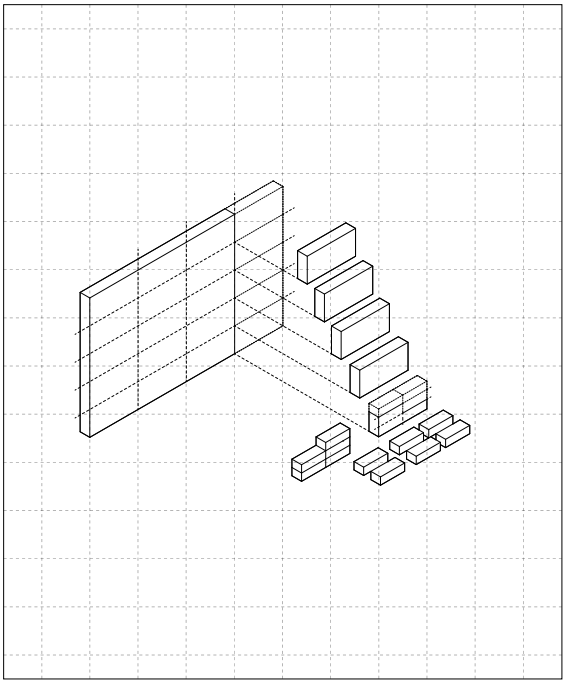


Figure 98. *Walking under a blazing sun*

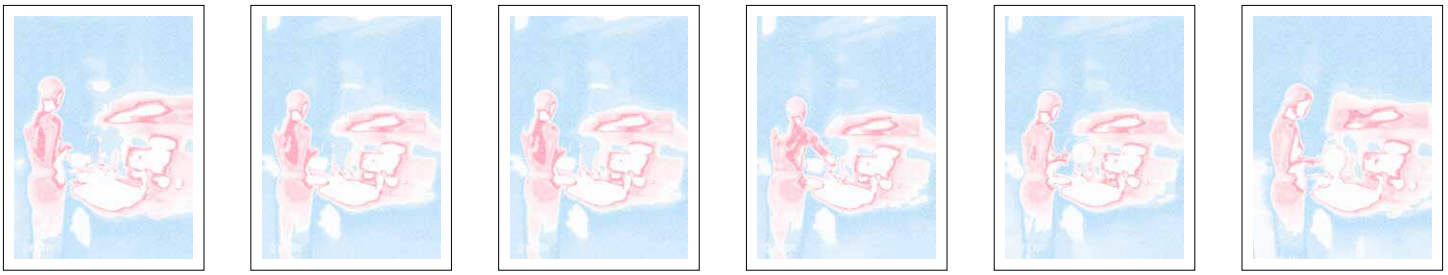
Figure 99. *Warm cooking station*

Figure 100. *Resting against cold concrete*

Figure 101. *Warm air leaving solar chimney*

Figure 102. *Thermal exchange with concrete*

99.



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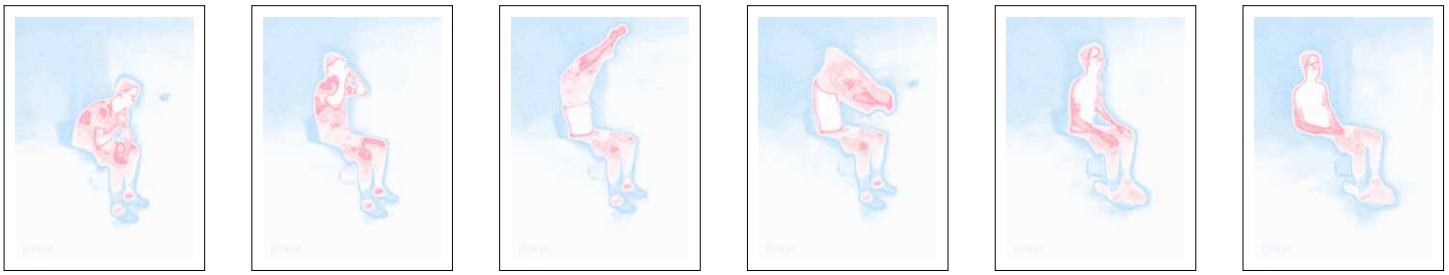

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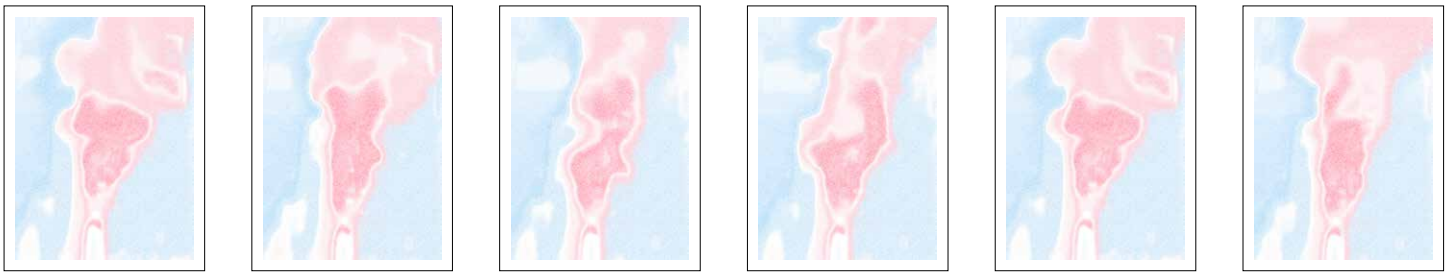

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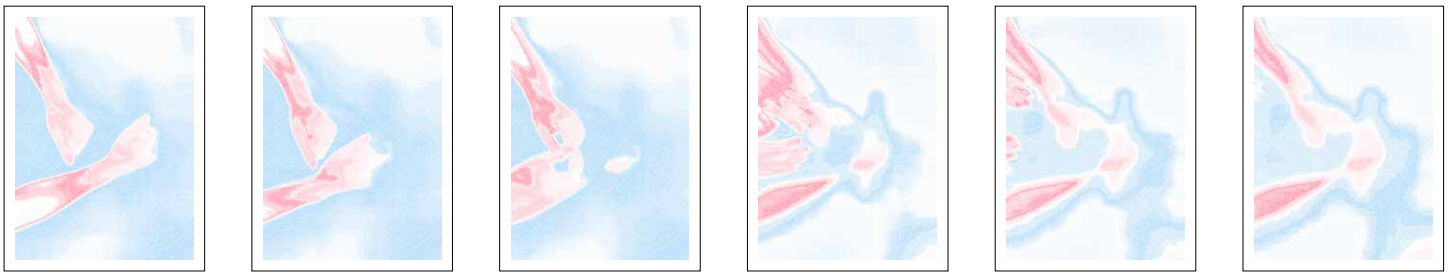


102.

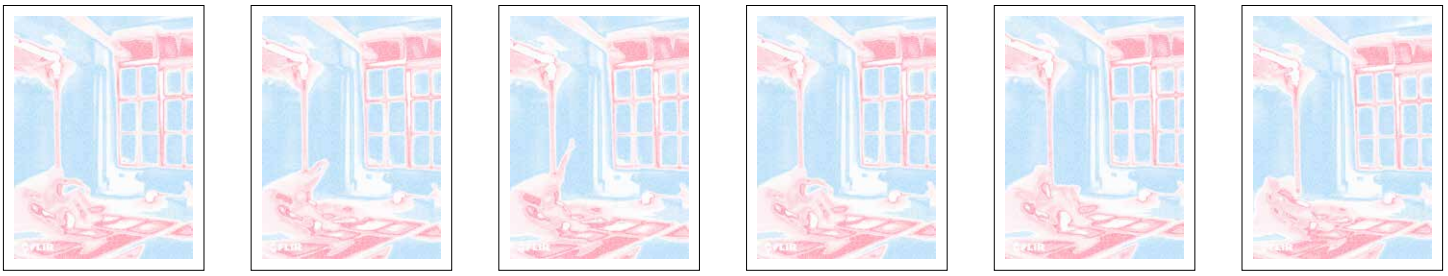
Figure 103. *Solar radiation accumulating behind the glass*

Figure 104. *Warm objects as a local source of conditionning*

Figure 105. *Radiative heat of a sleeping body*

Figure 106. *Layering to lower radiative transfer*

Figure 107. *Walking in the cold*



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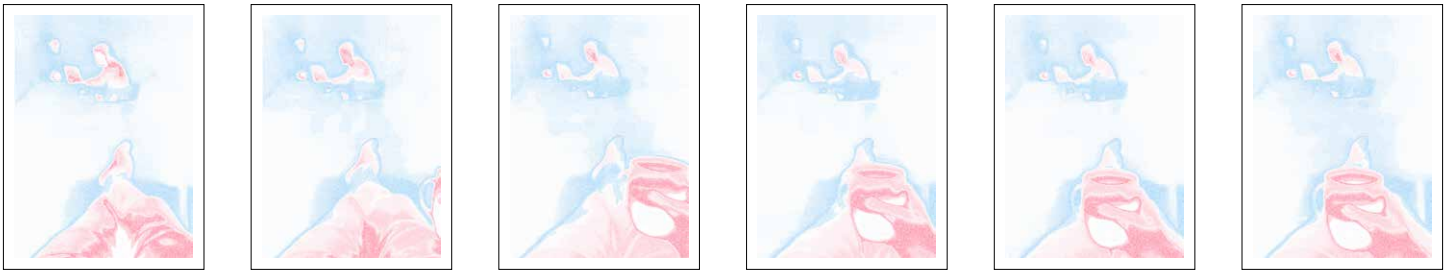

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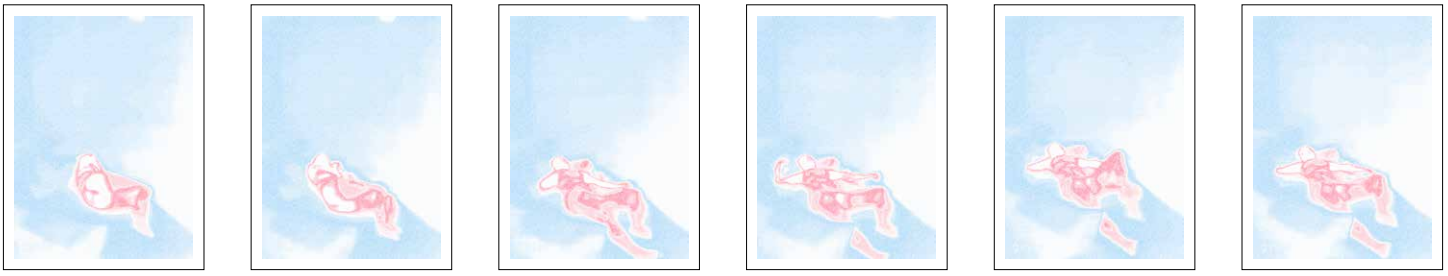

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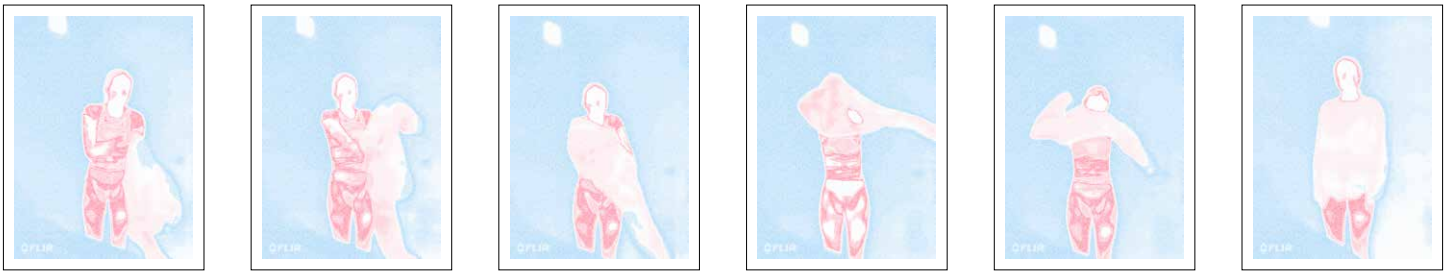

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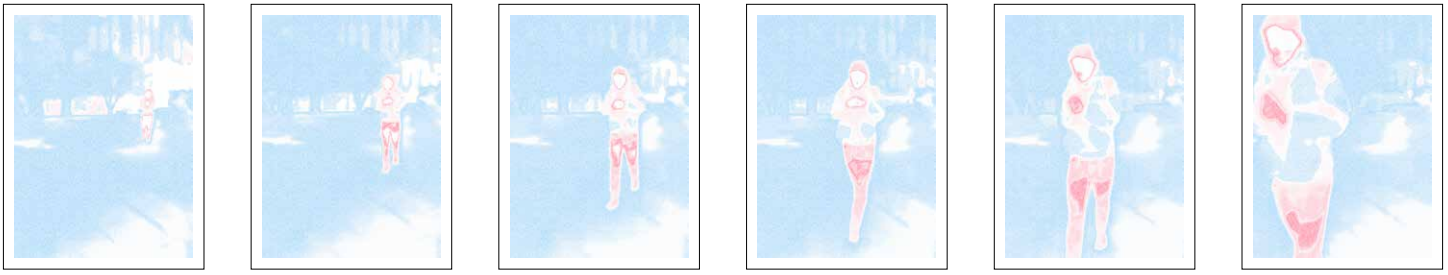
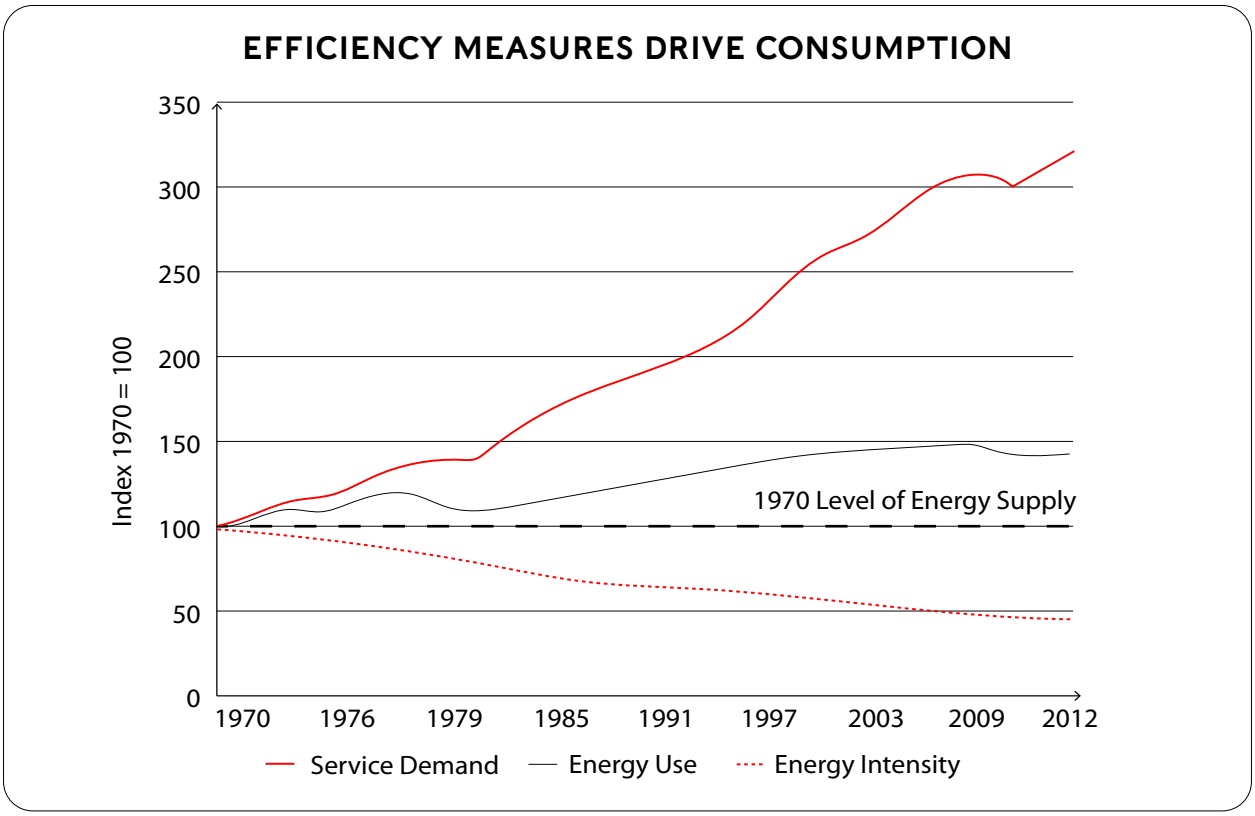


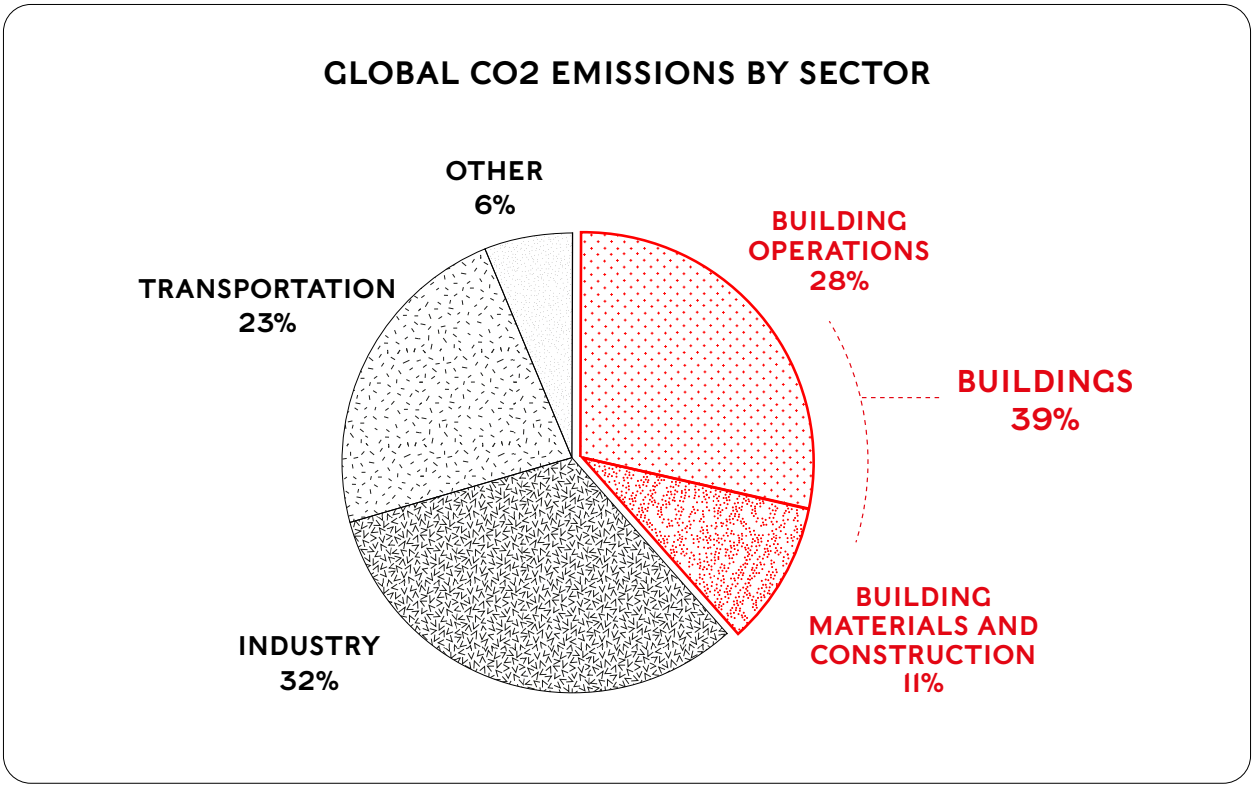
107.

Figure 108. *Efficiency measures drive consumption.*
Source: John Laitner, 2013, "Efficiency Is a More Important Economic Driver Than Energy Supply", American Council for an Energy-Efficient Economy

Figure 109. *Global CO2e emissions by sector.*
Source: Global alliance for Building and construction, 2018, Global Status Report.


EFFICIENCY MEASURES DRIVE CONSUMPTION
Index 1970 = 100
350
300
250
200
150
100
50
0
1970 Level of Energy Supply
1970
1976
1979
1985
1991
1997
2003
2009
2012
Service Demand
Energy Use
Energy Intensity

108.


GLOBAL CO2 EMISSIONS BY SECTOR
OTHER
6%
BUILDING
OPERATIONS
28%
TRANSPORTATION
23%
BUILDINGS
39%
INDUSTRY
32%
BUILDING
MATERIALS AND
CONSTRUCTION
11%

109.

Figure 110. *Deconstruction photo-collage 01*

Figure 111. *Deconstruction photo-collage 02*

Figure 112. *Deconstruction photo-collage 03*

110.

111.

112.

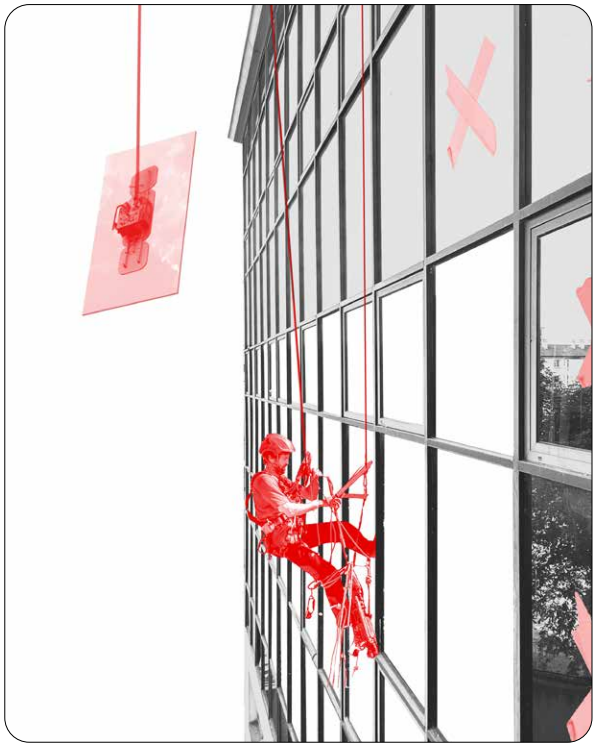
Figure 113. *Deconstruction photo-collage 04*

Figure 114. *Deconstruction photo-collage 05*

Figure 115. *Deconstruction photo-collage 06*

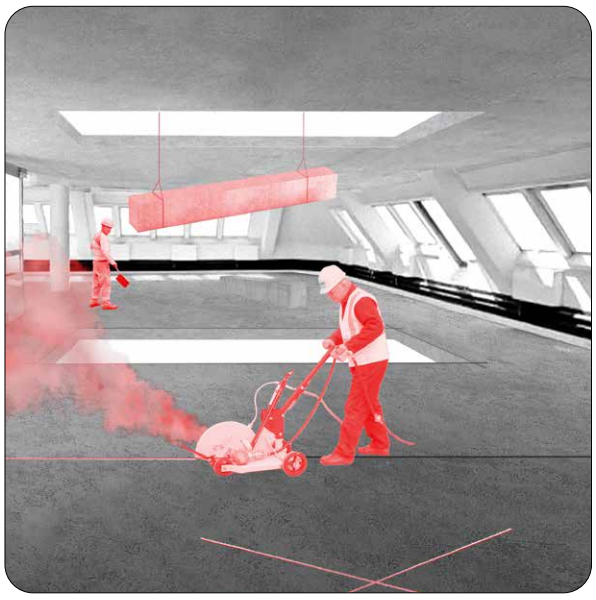
Figure 116. *Deconstruction photo-collage 07*

113.



114.

115.



116.

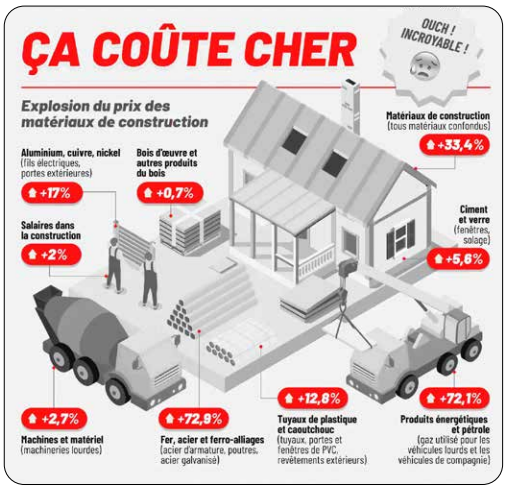
Figure 117. *Context photo-collage 01*

Figure 118. *Context photo-collage 02*

Figure 119. *Context photo-collage 03*

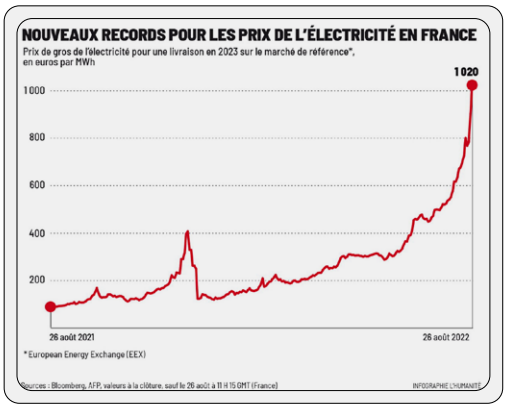
Figure 120. *Context photo-collage 04*

Figure 121. *Context photo-collage 05*



117.

118.



119.

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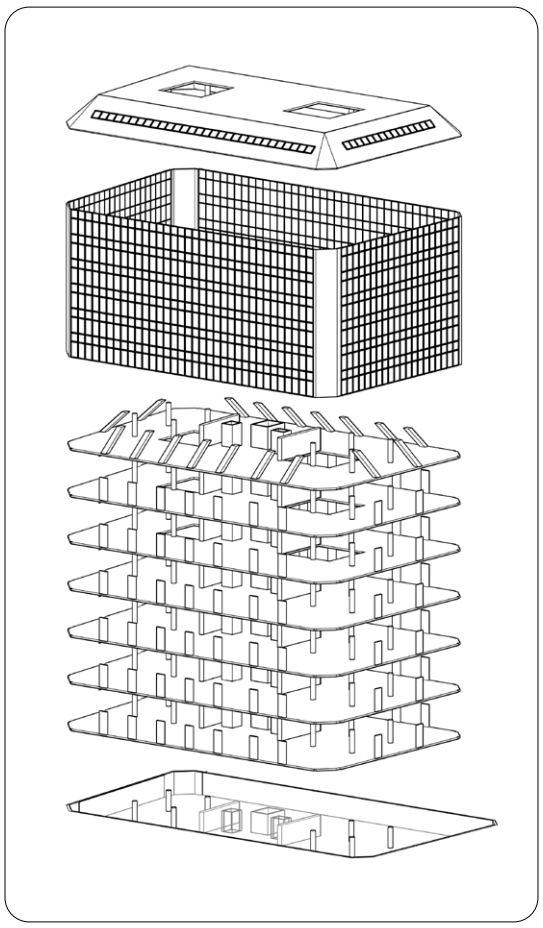
121.

Figure 122. *Exploded axonometry, existing material condition*

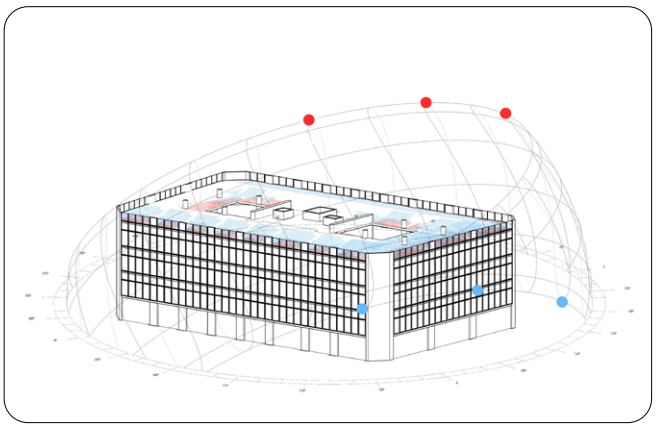
Figure 123. *Exploded axonometry, existing solar gains*

Figure 124. *Exploded axonometry, existing HVAC systems*

Figure 125. *Photo-collage, axonometry of existing condition*



122.



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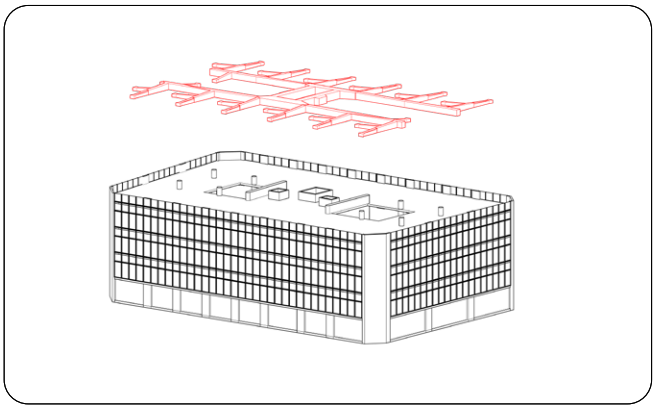
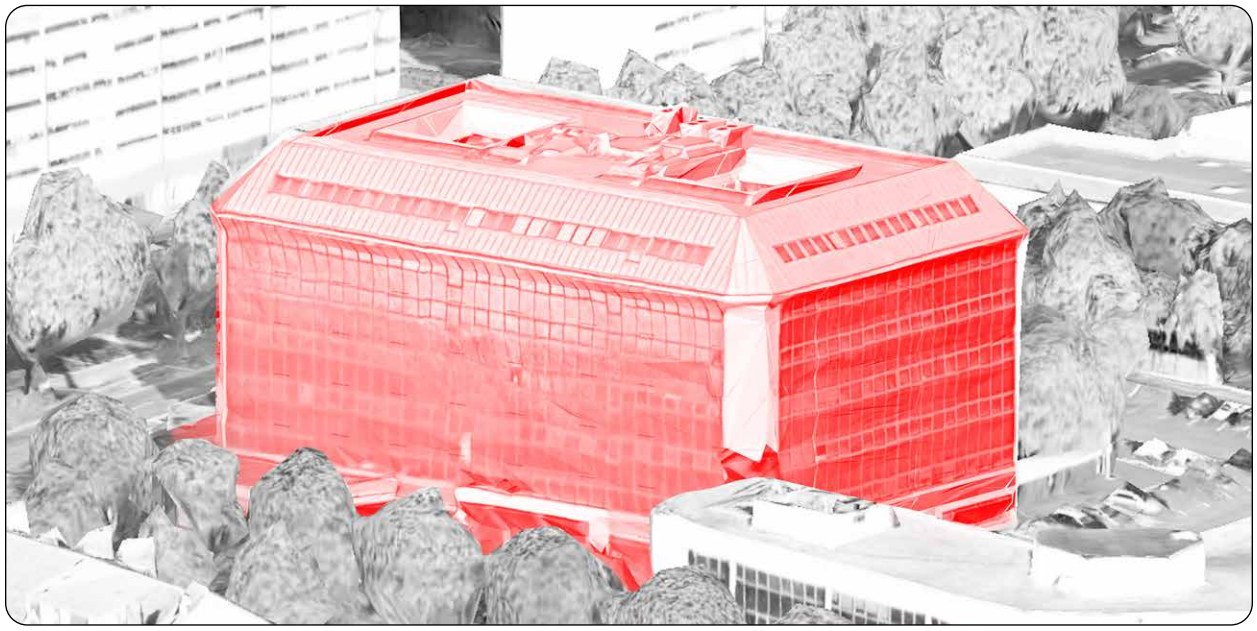


124.



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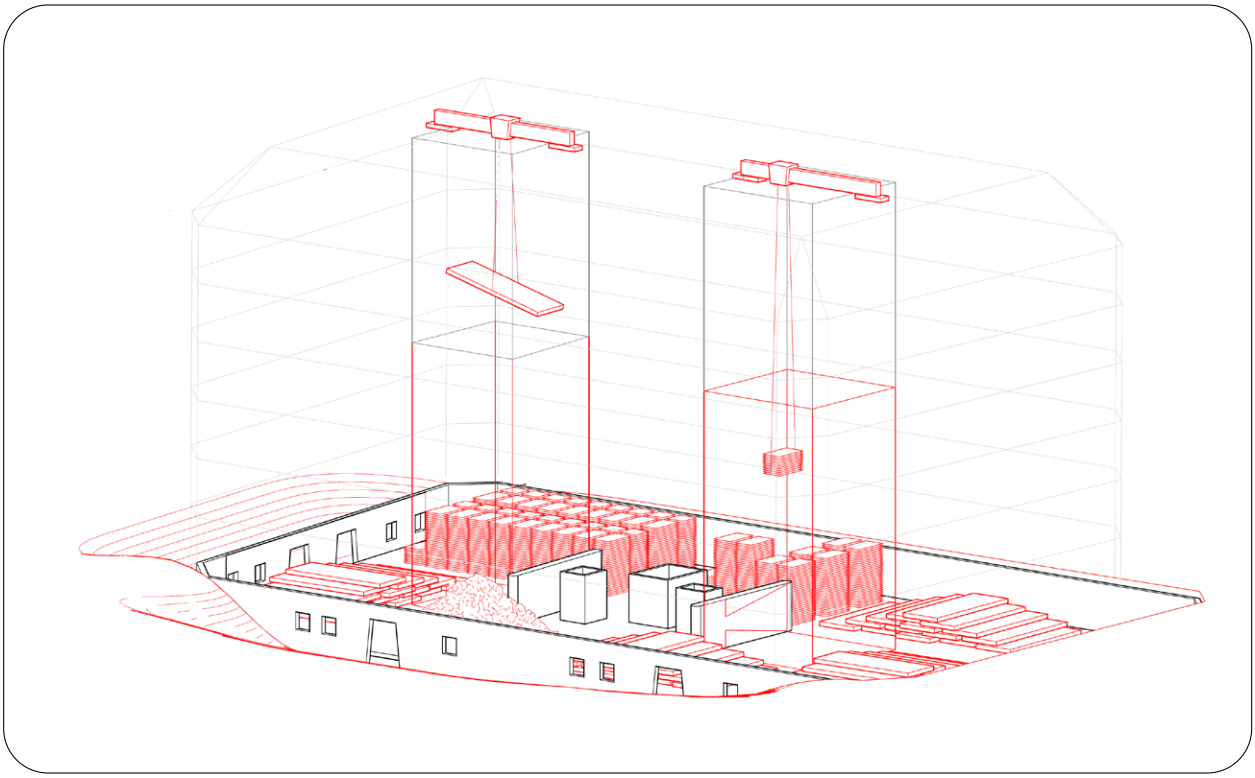
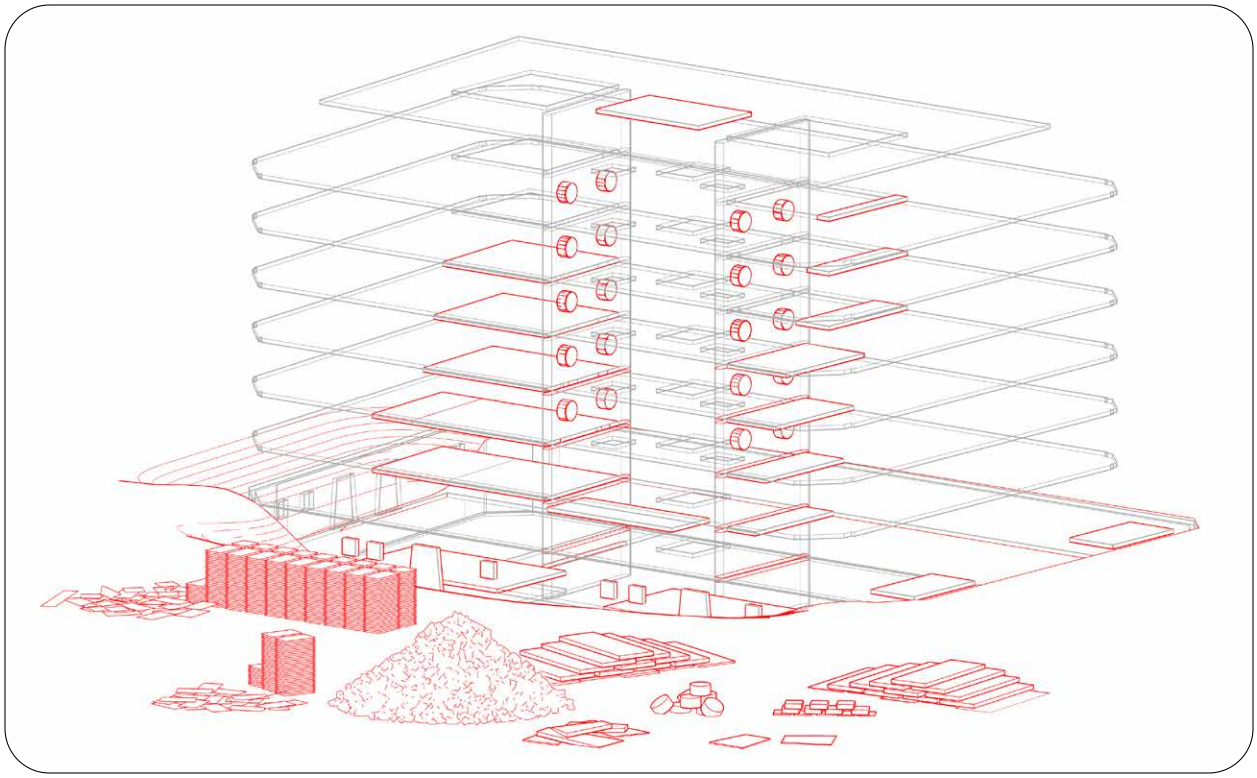


126.

Figure 126. *Exploded axonometry, material rearrangements 01*

Figure 127. *Exploded axonometry, material rearrangements 02*

Figure 128. *Exploded axonometry, material rearrangements 03*



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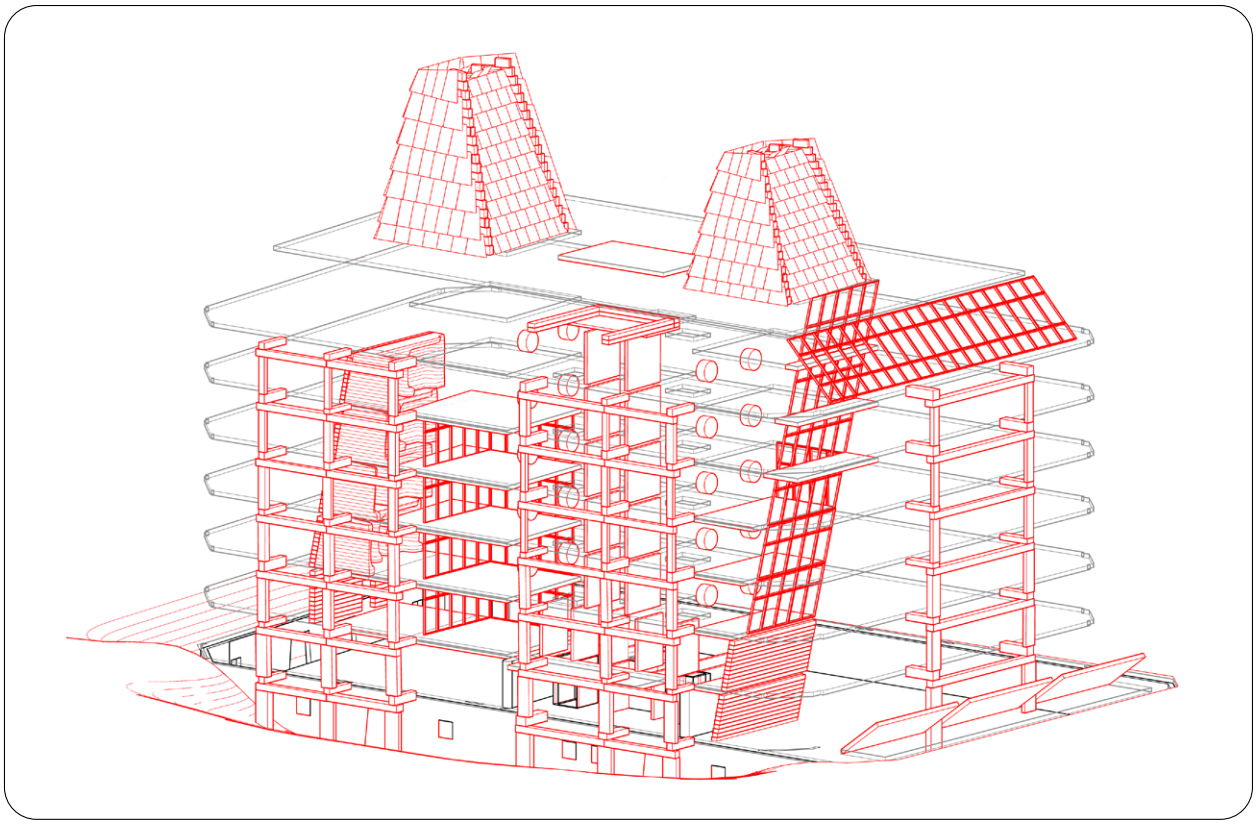

128.

Figure 130. *Thermal Manifesto*

THERMAL COLLECTIVE MANIFESTO

Paris, 16th July 2024,

In light of the shrinkage of our comfort induced by the current context of energy scarcity, we are calling for thermal and material intelligence to formulate a new collective way of dwelling. The thermal collective is our proposal alternative to overcome the dying paradigm of modern comfort and retrieve quality in domesticity; it will ask for new knowledges, skills, priorities and forms of expertise. The architectural project that supports our novel collective dwelling endeavor will reify the following fundamentals:

1. LIVING WITH THERMAL PROPERTIES AND CLIMATE

We need to dwell in tune with thermal properties and climatic variations. This means harnessing the naturally occurring vertical air-flows, leveraging materials' thermal conductivity and heat capacity, and embracing seasonality and temporal use. All these principles will allow us to reduce reliance on fuel-based active conditioning

2. COLLECTIVIZING LIVING SPACE

We need to collectivize living spaces. This means minimizing individual private spaces in favor of shared programs and amenities. It will enable access to a larger variety of spaces, programs and indoor climates and offer a viable alternative to private uniform comfort.

3. APPLIYING THERMAL INTELLIGENCE TO MATERIAL ETHIC

We need to rethink construction and maintenance. This starts on the construction site, with the reuse of an existing building and the re-arrangement of the existing material. It will extend in a DIY low-tech attitude to the fabrication and maintenance of the interior fit-outs designed around legibility and hackability. This material ethic stems excessive material extraction and waste.

130.

Figure 131. *Survey of modern office buildings in Paris*

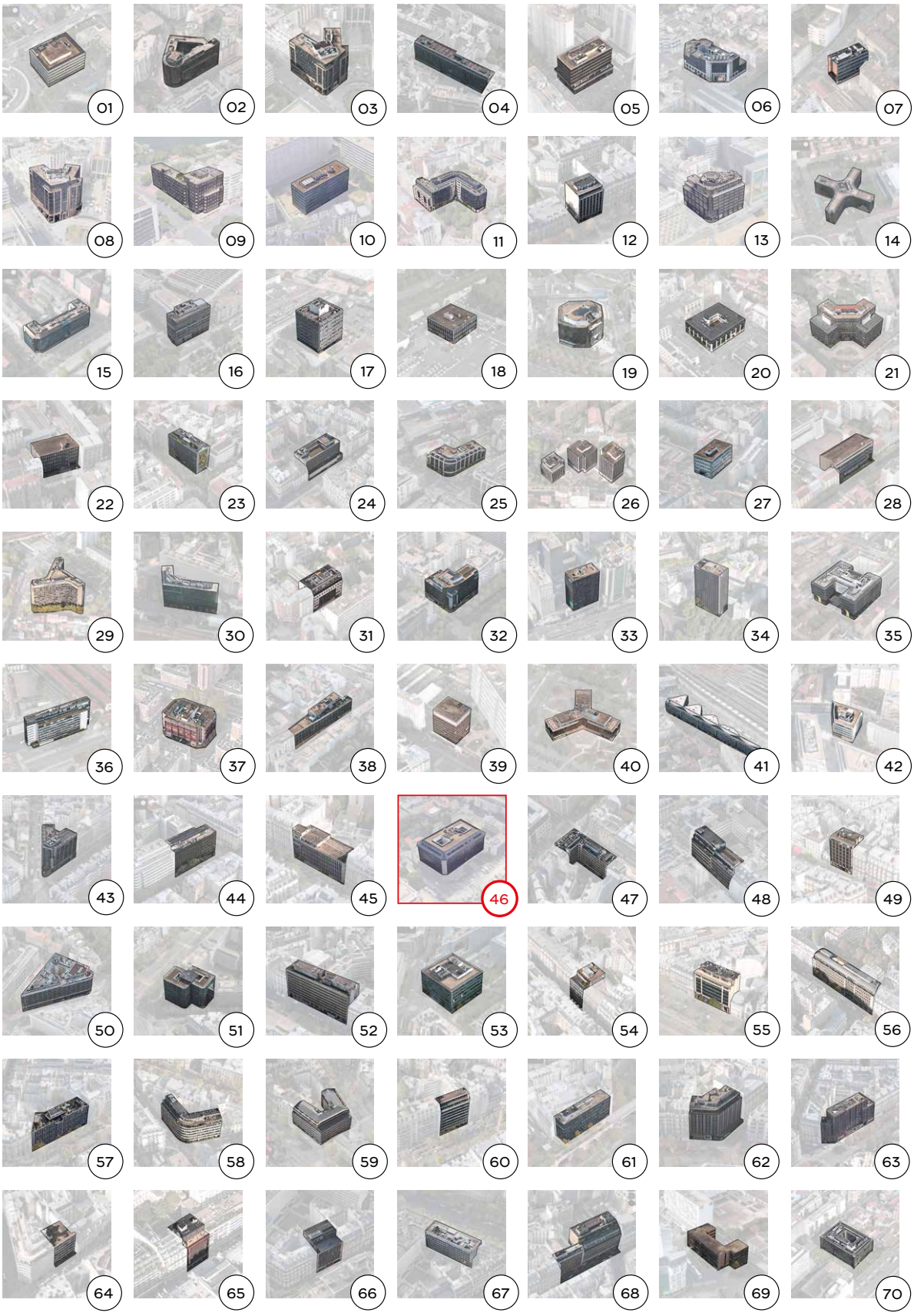
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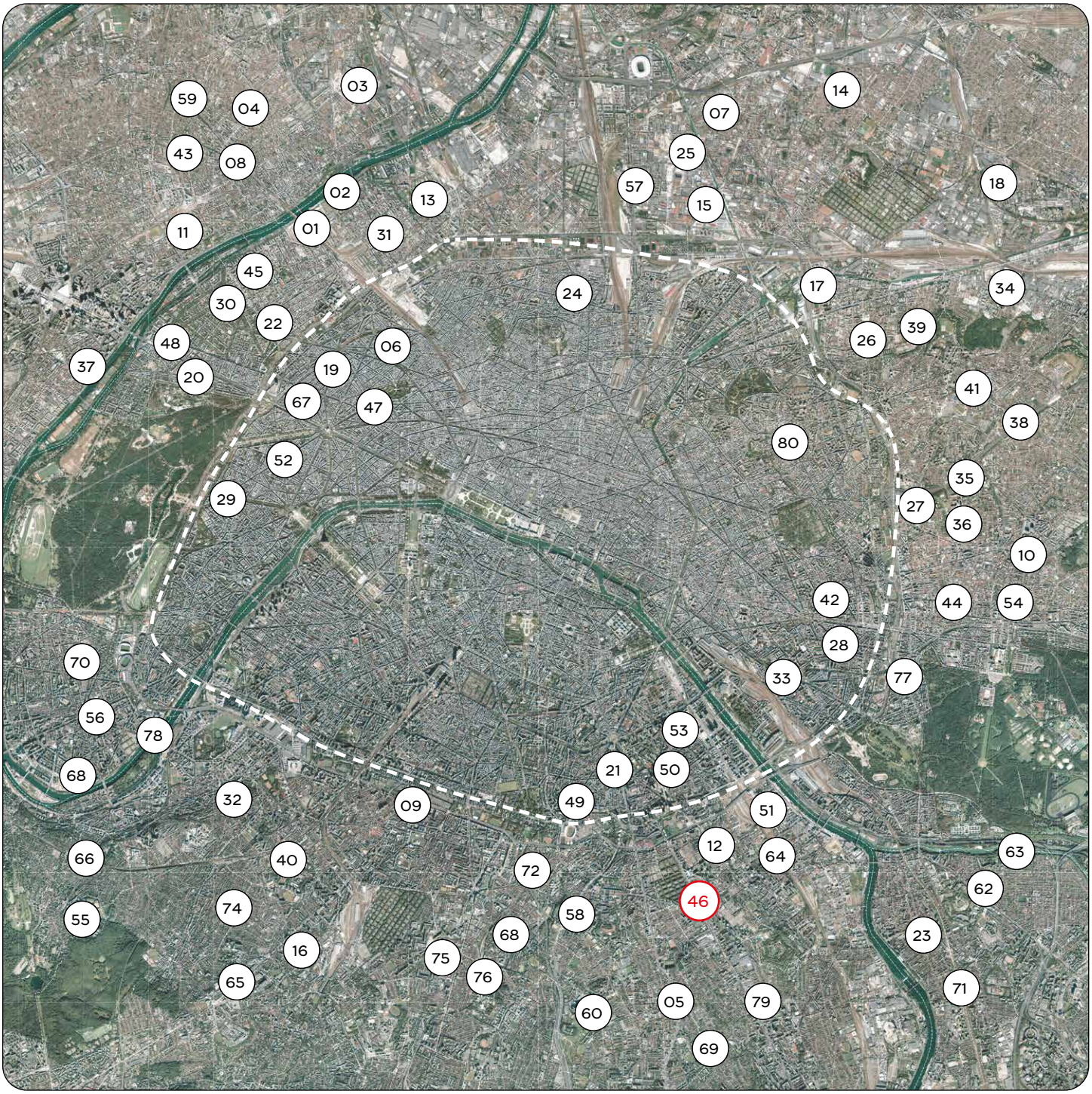
Figure 132. *Survey of modern office buildings in Paris. Map source: APUR*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132.

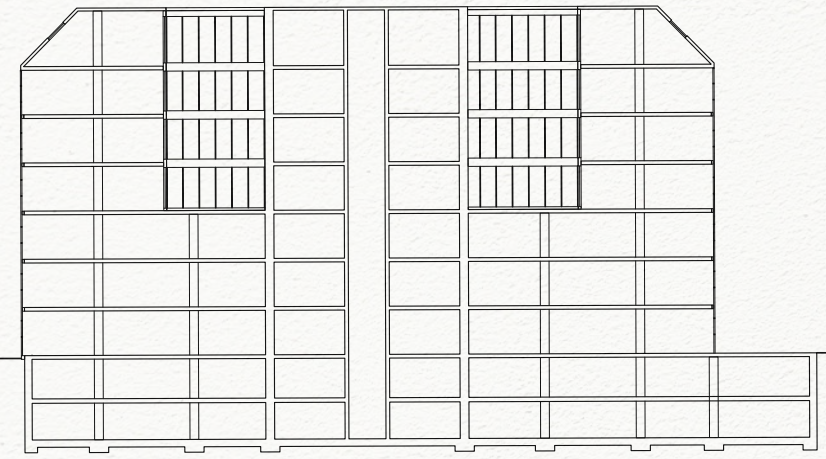
Figure 133. *Existing plan and section*

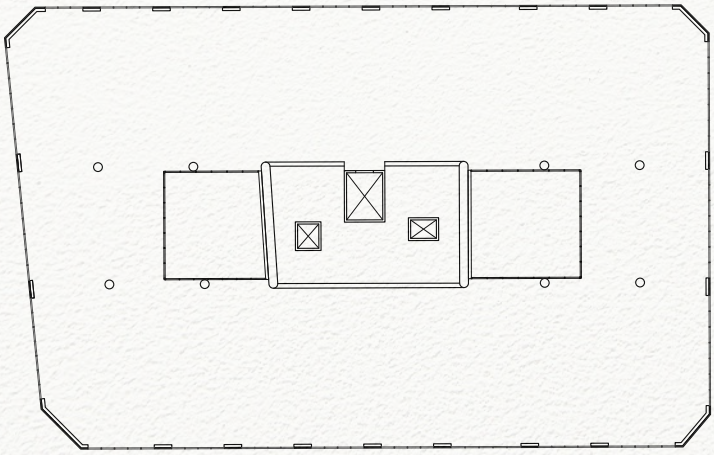
ESQ_001
EXISTING PLANS

PARIS
16 JUILLET 2024

PHASE D'ETUDE

Réarrangement thermique d'un bâtiment de bureau moderne pour co-opérative de logements collectifs.





MAÎTRE D'ŒUVRE

Co-opérative "Collectif thermique"
161 Ave. de Verdun
94200 Ivry sur Seine

LÉGENDE

- Existant
- Démolition
- Extension

MAÎTRE D'OUVRAGE

HEATSCAPES
Ré-aménagement thermique
23 Rue Renaudes
75012 Paris

133.

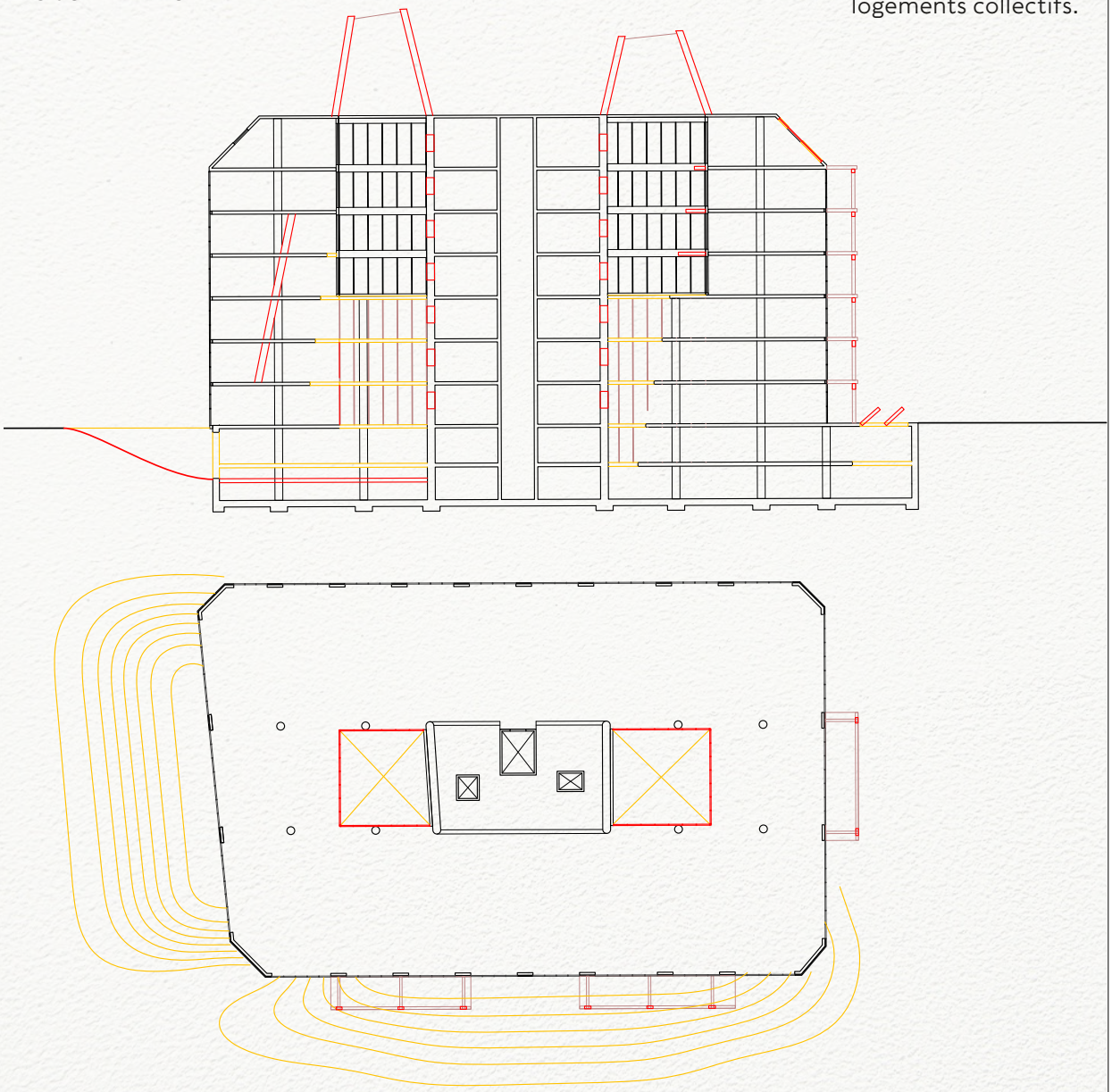
Figure 134. *Re-arrangement plan and section*

ESQ_002
RE-ARRANGEMENT PLANS

PARIS
16 JUILLET 2024

PHASE D'ETUDE

Réarrangement thermique d'un bâtiment de bureau moderne pour co-opérative de logements collectifs.



MAÎTRE D'ŒUVRE

Co-opérative "Collectif thermique"
161 Ave. de Verdun
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LÉGENDE

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MAÎTRE D'OUVRAGE

HEATSCAPES
Ré-aménagement thermique
23 Rue Renaudes
75012 Paris

134.

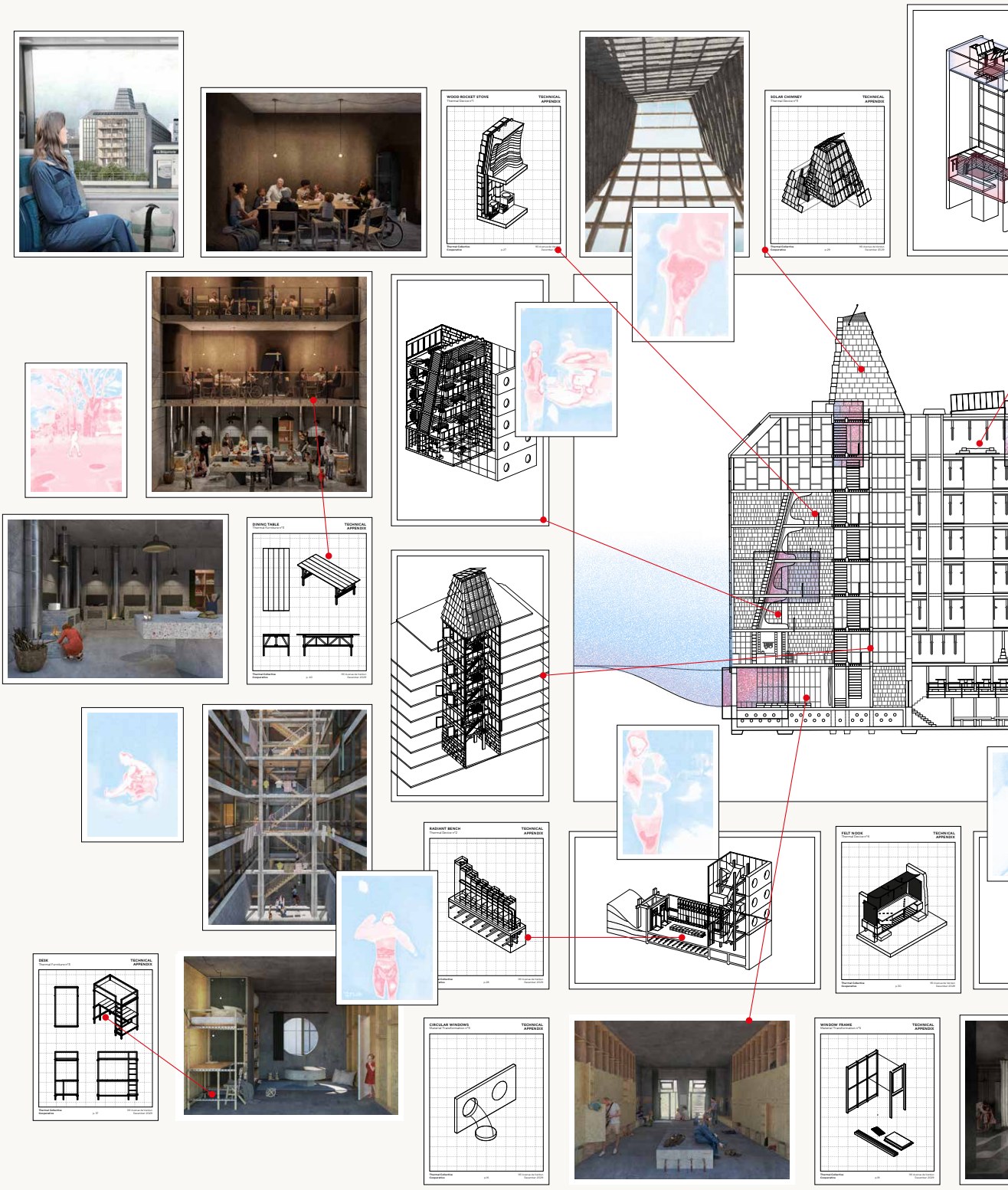

Figure 135. *Layout*