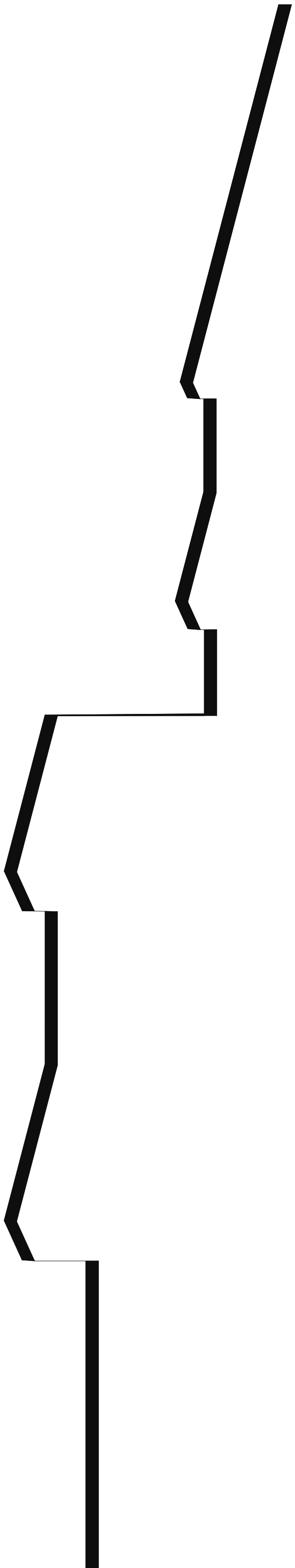
Reactivate Micafil



Research Booklet
Tommaso Delcò
Studio Tom Emerson + A/S research group, Illias Hischier
Master Thesis Autumn 2023

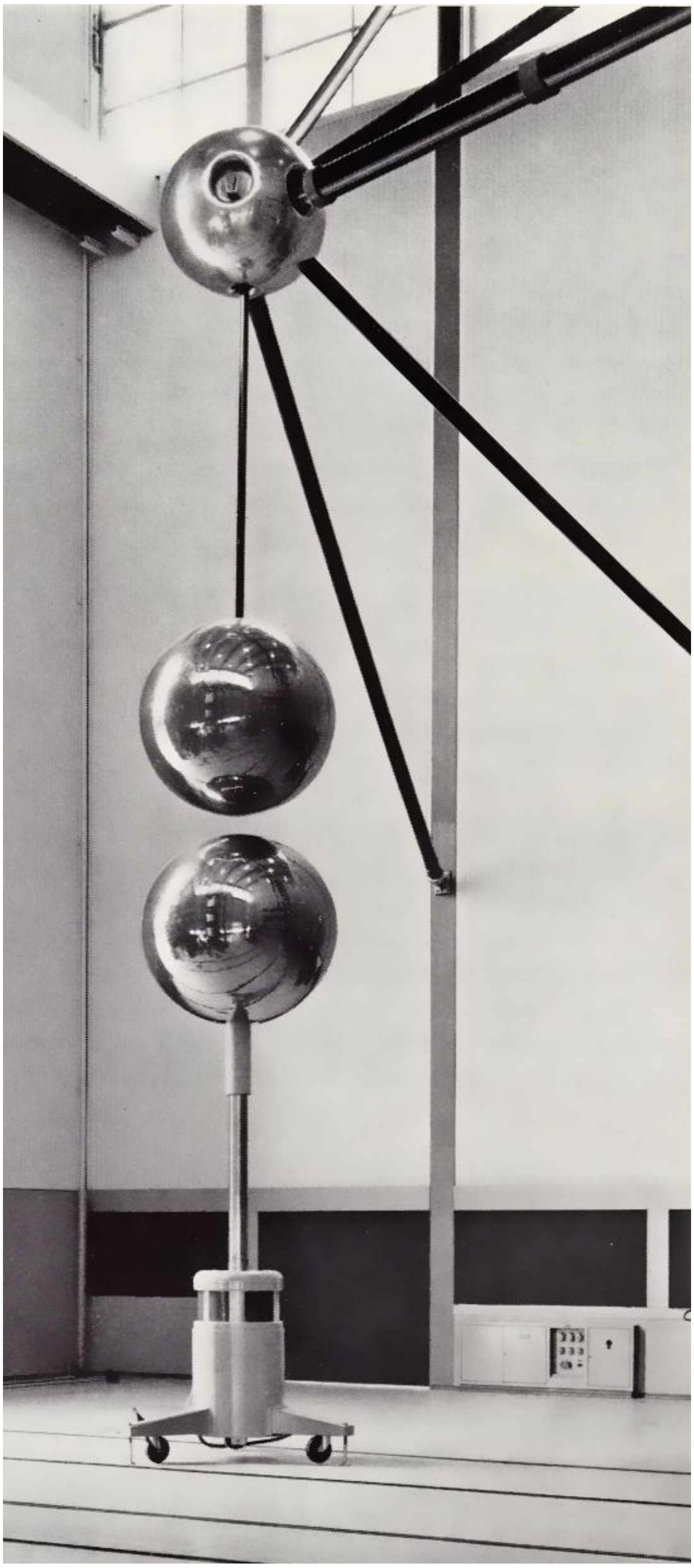
Oil crisis

In the wake of the 1973 oil crisis, the world found itself in the midst of an energy revolution. Triggered by the OPEC oil embargo, this pivotal event sent shockwaves through global economies and triggered a fundamental shift in energy policy. One of the most remarkable consequences of the crisis was the newfound focus on solar energy and its potential to alleviate the world's dependence on fossil fuels.

Governments, industries, and environmental advocates began to invest in solar technology. The crisis had laid bare the vulnerabilities of an oil-dependent world, prompting a shift towards a diversified energy portfolio.

MICAFIL - Evolution

MICAFIL, founded in 1918 and headquartered in Zurich, Switzerland, has established itself as a technology leader in the development, production and sale of special electrotechnical products.



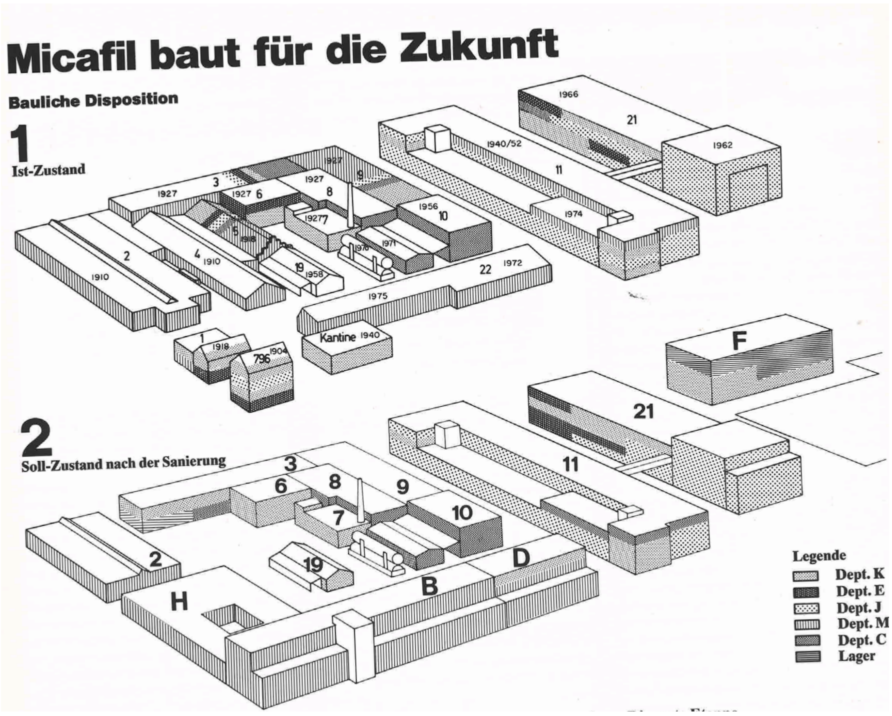
Since the first oil crisis in 1973, Micafil has systematically dedicated itself to the problems of energy value analysis and the possibilities of eco-technology, with the triple aim of:

- reduce the consumption of heating oil, electricity and water
- contribute to environmental protection
- compensate, as far as possible, for the increase in the price of energy sources

Parallel to this new current of thought, the electricity company found itself with a growing need for space in those years.

"The spatial conditions of our Altstetten site no longer meet our needs in many areas. For this reason, over several years, our planning office, KB, has worked closely with departments to develop a comprehensive concept that will allow us to create optimal spatial conditions in five distinct construction phases."

Der Direkte Draht - February 1977



"The basis for this extensive planning work consisted of the following objectives:

- *Creation of modern workplaces, especially in the M department and partially in the C department.*
- *Consolidation of areas in operation and offices that need close daily interaction.*
- *Improvement of production processes and material flow.*
- *Extensive consolidation of the current site.*
- *Enhancement of operational oversight.*
- *Removal of Blocks 4 and 5 ("Vereinigte Hüttenwerke")."*

Der Direkte Draht - February 1977

The first phase involves completing Block B as the initial step.

This building, measuring 95 meters in length and 25 meters in height along Badenerstrasse, will consist of two workshop floors and two office floors. It will house the larger areas of assembly and painting of large machines, assembly of wire cutting machines, testing workshop, small workshop, apprentice workshop, component and intermediate storage, demonstration room, and most of the “M department” offices, including wardrobes.

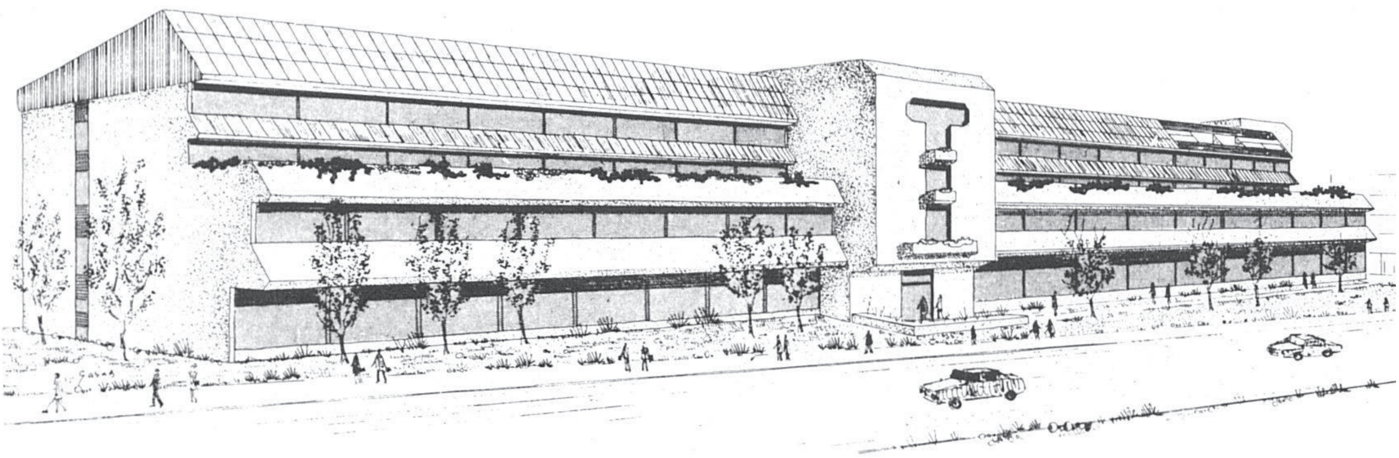
The construction program is divided into 9,000 square meters of space as follows:

- 1,800 square meters = Offices for technical development, production planning, and sales.
- 2,000 square meters = Workshops for assembly and testing, apprentice workshop, demonstration room, and painting.
- 2,000 square meters = Inventory warehouse with high shelving, other warehouses, and archives.
- 3,000 square meters = Circulation areas, technical rooms, annexes, wardrobes, and showers.
- 200 square meters = ‘Zivilschutz’ room.

To construct the new Block B, it is necessary to first remove the old houses along Badenerstrasse.

The construction of the new factory aimed to consider the following in terms of construction, taking into account the latest ecological discoveries:

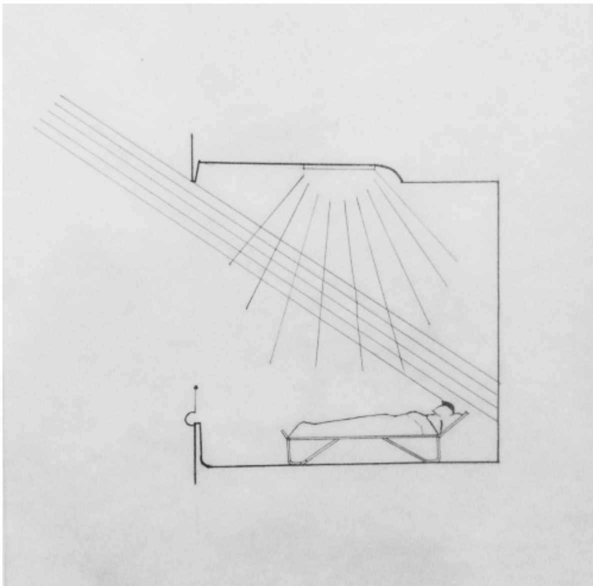
- Use of solar energy.
- Utilization of solar energy and the residual heat from the workshops.
- Effective insulation.
- Cost-effective glass surfaces.
- Good natural workplace lighting.
- Economical water consumption



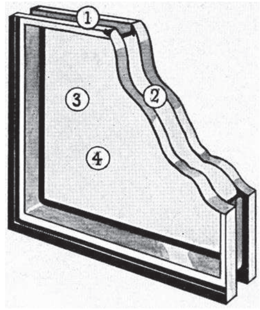
Solar approach

Architects in the modernism start to focus their attention to the sun and the way sunlight reaches the interior.

Sunlight, often viewed as a vital element, was not only harnessed for its aesthetic qualities but also for its potential to improve hygiene within interior spaces. It was seen as a natural disinfectant, and its presence helped to eliminate dark, damp corners where germs could thrive. By incorporating ample sunlight, modernist architects aimed to promote cleanliness and well-being, which aligned with the overall ethos of progress and improved quality of life that modernism represented.



In the late 1930 innovative designs that sought to harness the sun's potential for climate control within buildings, emerged.



One key factor that contributed to this shift was the development of new glass technologies. These advancements in glass manufacturing made possible to create windows and facades that could effectively capture and control the entry of sunlight. by strategically using or avoiding direct sunlight, depending on the season, the internal climate of a building could be manipulated. This approach aimed to create more comfortable and energy-efficient living and working environments. Architects started considering factors like the angle and placement of windows and the use of shading devices to optimize natural lighting and temperature regulation.

Simultaneously, at institutions like the Massachusetts Institute of Technology (MIT), researchers were conducting experiments to store and utilize solar energy for heating purposes. This research involved developing methods to capture, store, and distribute solar-generated heat, especially for the use during periods of bad weather when sunlight was scarce.

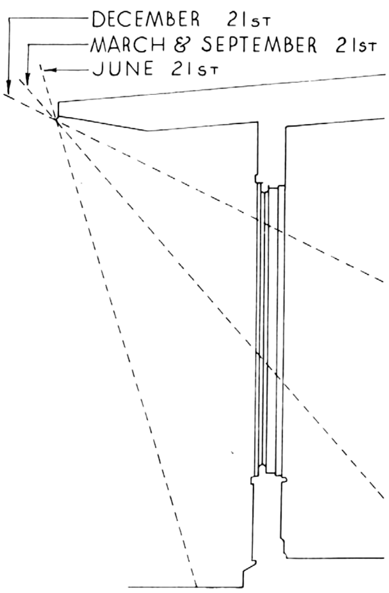
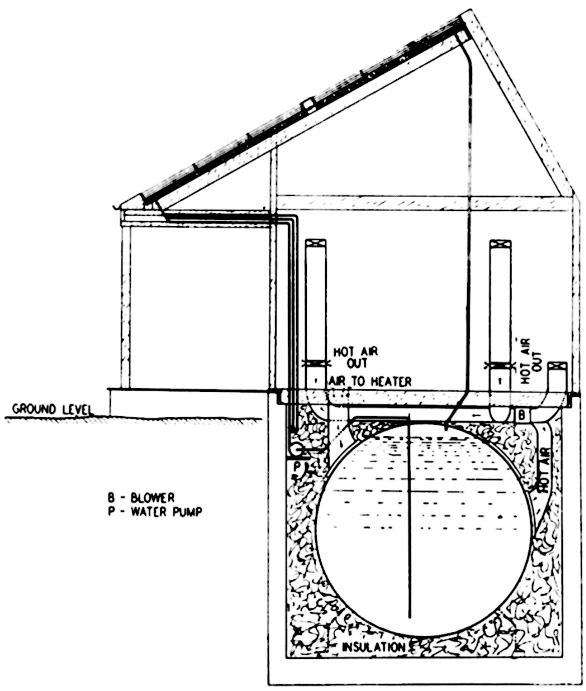


DIAGRAM OF SUN ANGLES
FOR CHICAGO LATITUDE

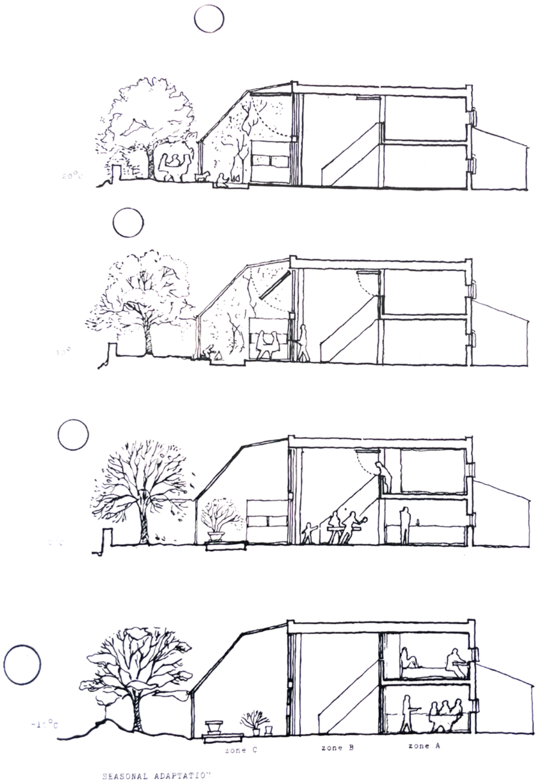


These two developments marked a significant division. On one side emerged the concept of utilizing solar energy through passive technologies, while on the other, there were those pursuing active methods.

Passive Technologies

Passive solar technologies are methods and design principles that harness the sun's energy without the need for mechanical or electrical devices. These techniques are primarily used for heating, cooling, and lighting buildings and are characterized by their simplicity and reliance on natural processes.

They represent the most straightforward approach to converting solar radiation into usable heat within buildings. They stand in contrast to conventional heating methods, as residents actively participate in the thermal management of their homes, often by adjusting curtains or other shading devices. Passive systems are highly influenced by outdoor climate and meteorological conditions, fostering a greater awareness of the environment.



Direct Gain Systems

Greenhouses and Sunspaces

Trombe Walls

Reflective Surfaces

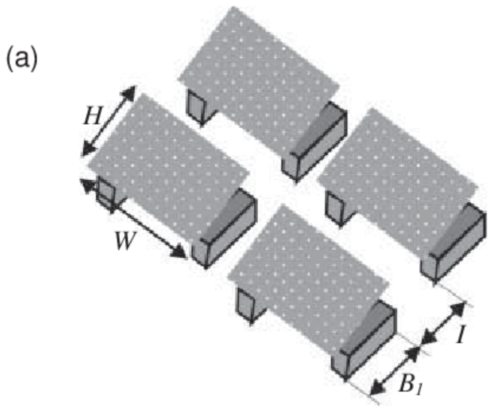
Shading Devices

Active Technologies

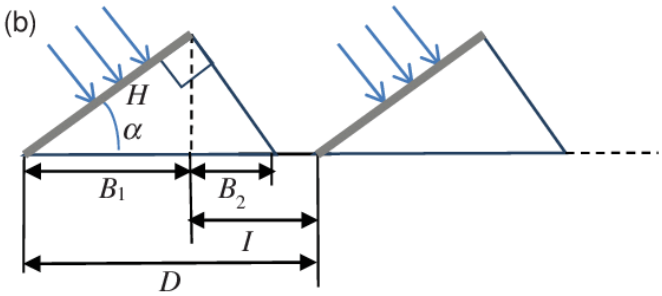
Active solar technologies are systems that harness and convert solar energy into usable heat or electricity through mechanical or electrical devices. These technologies actively collect, store, and distribute solar energy, providing a direct source of power for various applications.

Active solar technologies indeed rely on complex systems, often involving sophisticated equipment and components that may not be readily understandable to the end users.

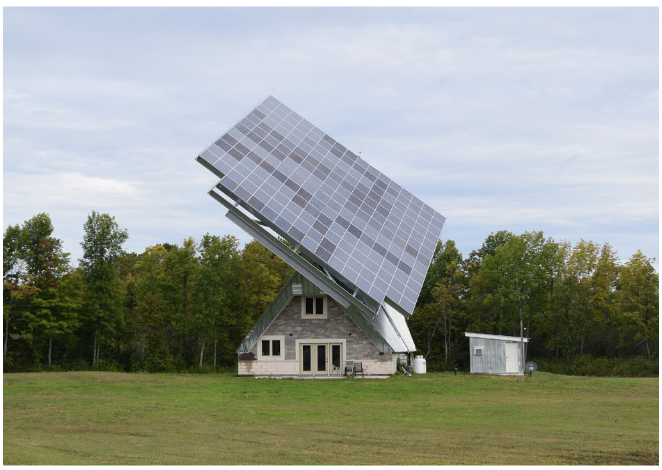
Moreover, active solar technologies are often conceived with the idea of industrialization and market viability. The goal is to create scalable solutions that can be produced on a larger scale, making them accessible to a broader market.



Physical layout



Geometrical layout



Solar Water Heating Systems

Solar Space Heating Systems

Concentrated Solar Power

Solar Photovoltaic Panels

Solar Battery Systems

MICAFIL - solar use

Pierre Robert Sabady, born in Hungary and residing in Switzerland, was the architect behind the "Maschinenfabrik" building of Micafil. He is considered one of the pioneers in the use of solar energy. From the mid-1970s, he authored several books on the subject and managed a specialized planning studio. In 1978, in an issue of the magazine *Werk/Archithese* dedicated to the theme of solar position, he published his "seven fundamental pillars of the biosolar architecture." These are intriguing because they describe crucial points for the energy system optimization of a building from an architectural perspective.

Sabady also touched on technical matters, but, for him, the spatial, volumetric, and material arrangement of the building was more important, factors relevant to design. In his words, this means:

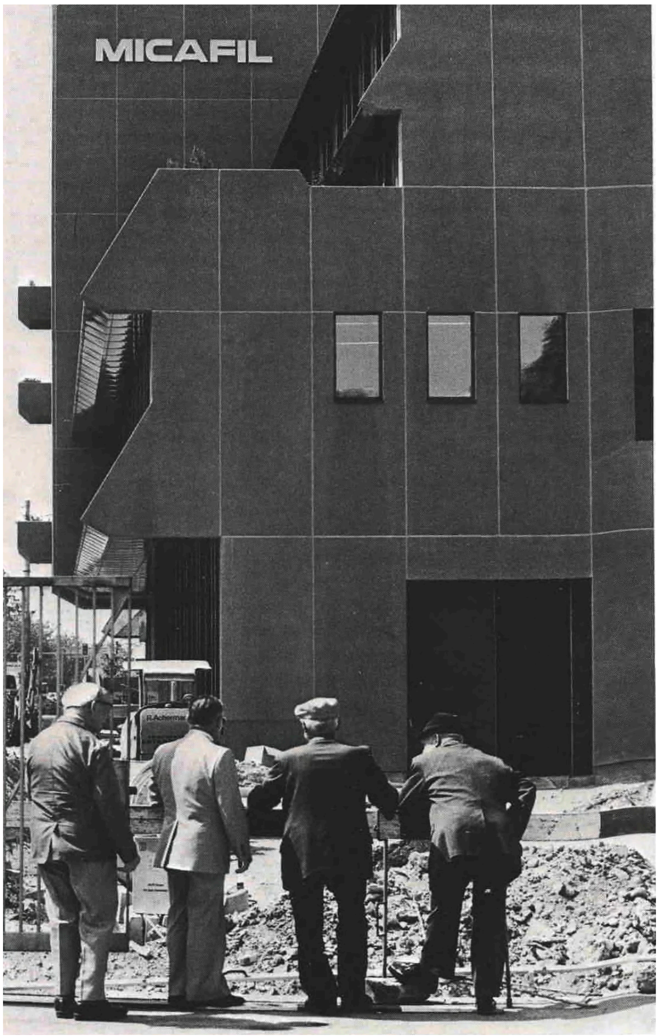
- optimized positioning
- outhern orientation
- thermal zone planning
- compact building volume
- the shape of the sloped roof
- overhangs for facade protection
- biophysically optimized building materials, components, and technical systems.

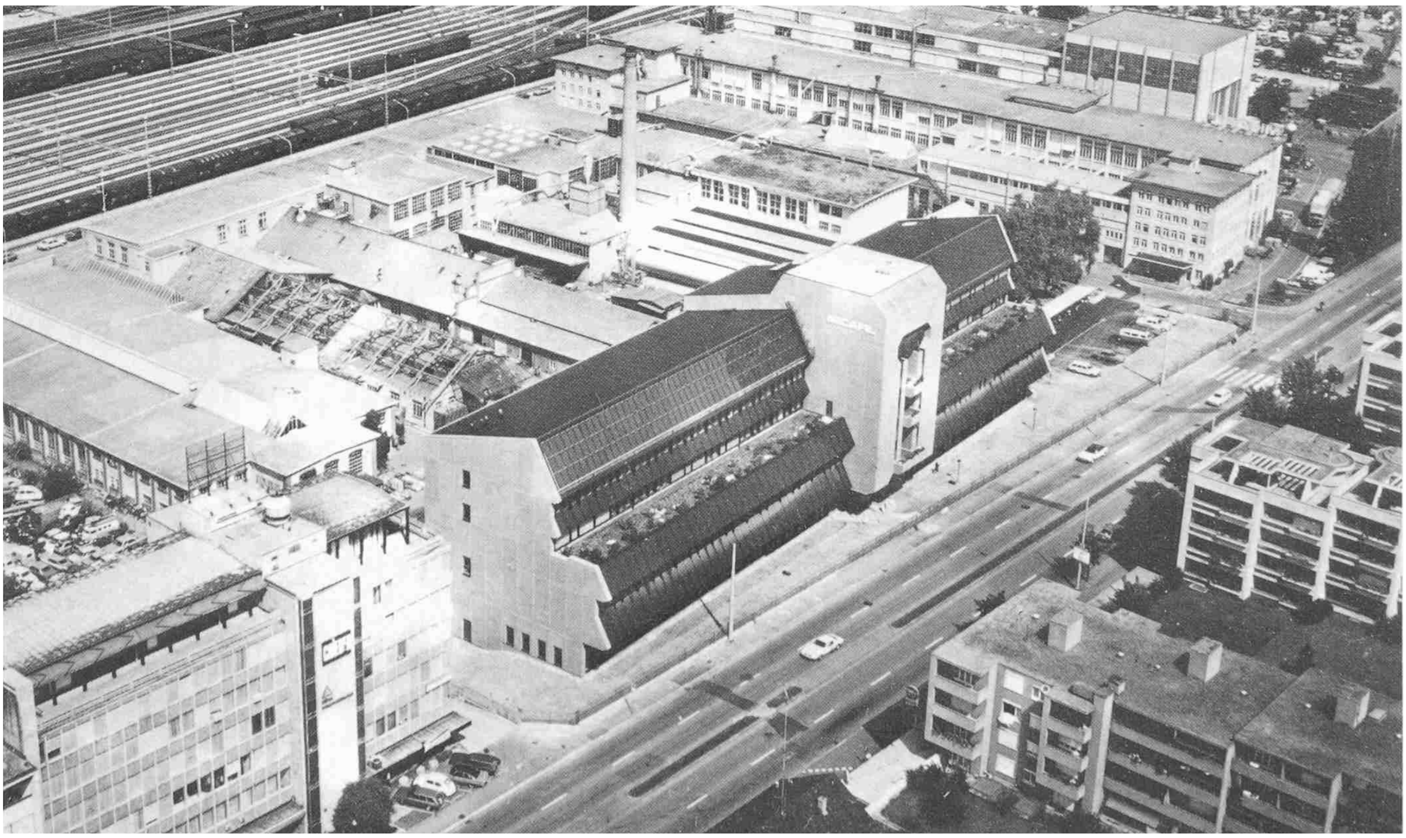
The architect sought to meet the needs of the Micafil company, achieving the following result:

In the centre is the core, which houses the main access to the building with stairs and lifts, as well as the toilets. To the side of the core, there are two floors of workshops to the left and to the right above them, two floors of offices, divided horizontally by slanting projecting parapets.

The sloping roof houses solar collectors for domestic water treatment and to support the heating system. It also provides a reserve of space for the later installation of heat accumulators or other installations. The conformation of the sills regulates the different incidence of sunlight in summer and winter and houses the air collectors for additional heating of the return air. The roof garden above the warehouse, fed by rainwater, protects the upper office wing from noise.

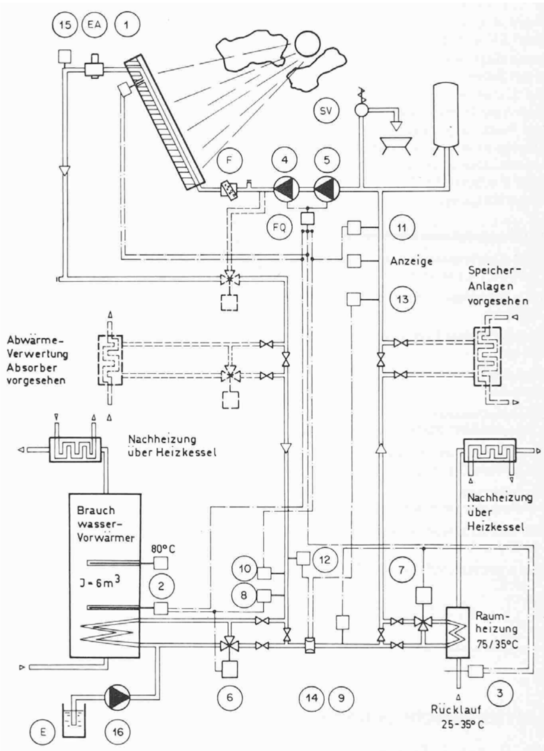
In summer, the sun's heat should completely guarantee the supply of hot water and contribute 40% to space heating. Taking the unusable solar surplus into account, an annual energy gain of about 60,000 kWh is expected. The consumption of heating oil is thus approximately 55% lower than a conventional building without additional energy-saving measures. This corresponds to a reduction in consumption of 63 tonnes of heating oil per year.

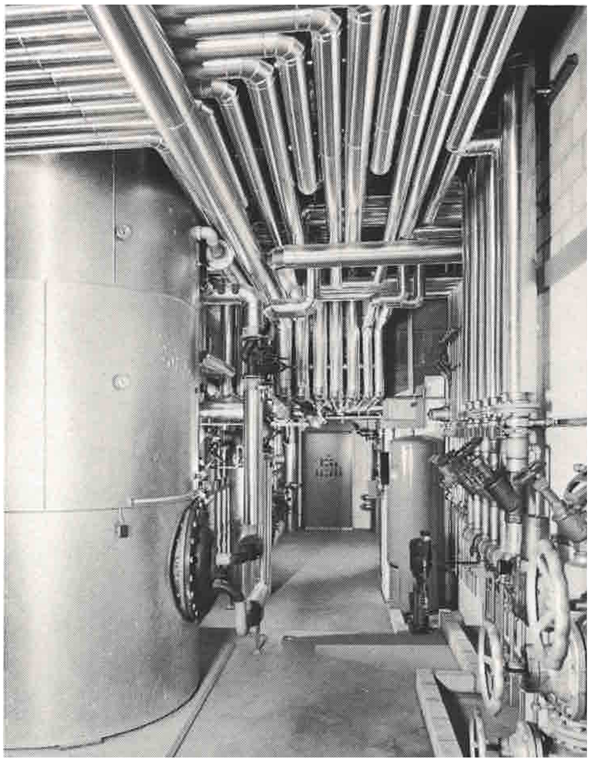




The Facade

The Micafil building, which relied a lot on active solar technology for its energy needs, experienced a range of challenges and complications in the years following its implementation. These issues ultimately led to the malfunctioning of various components and the performance of the system.
In particular the storage of energy posed difficulties. Active solar systems, particularly for large-scale applications like the Micafil building, require efficient energy storage solutions. Over time, these storage systems encountered issues, including many leaks on pipes and tanks, which then stopped working.





The Micafil building's experience highlights some of the common challenges associated with active solar technologies, demonstrating the need for careful planning, regular maintenance, and an understanding of the limitations and potential issues that can arise with such systems.

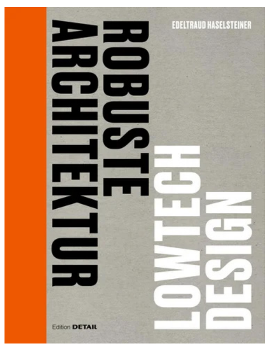
Complexity

Length adaptation phases

Need for specialized personnel

Short lifespan

Increased project cost

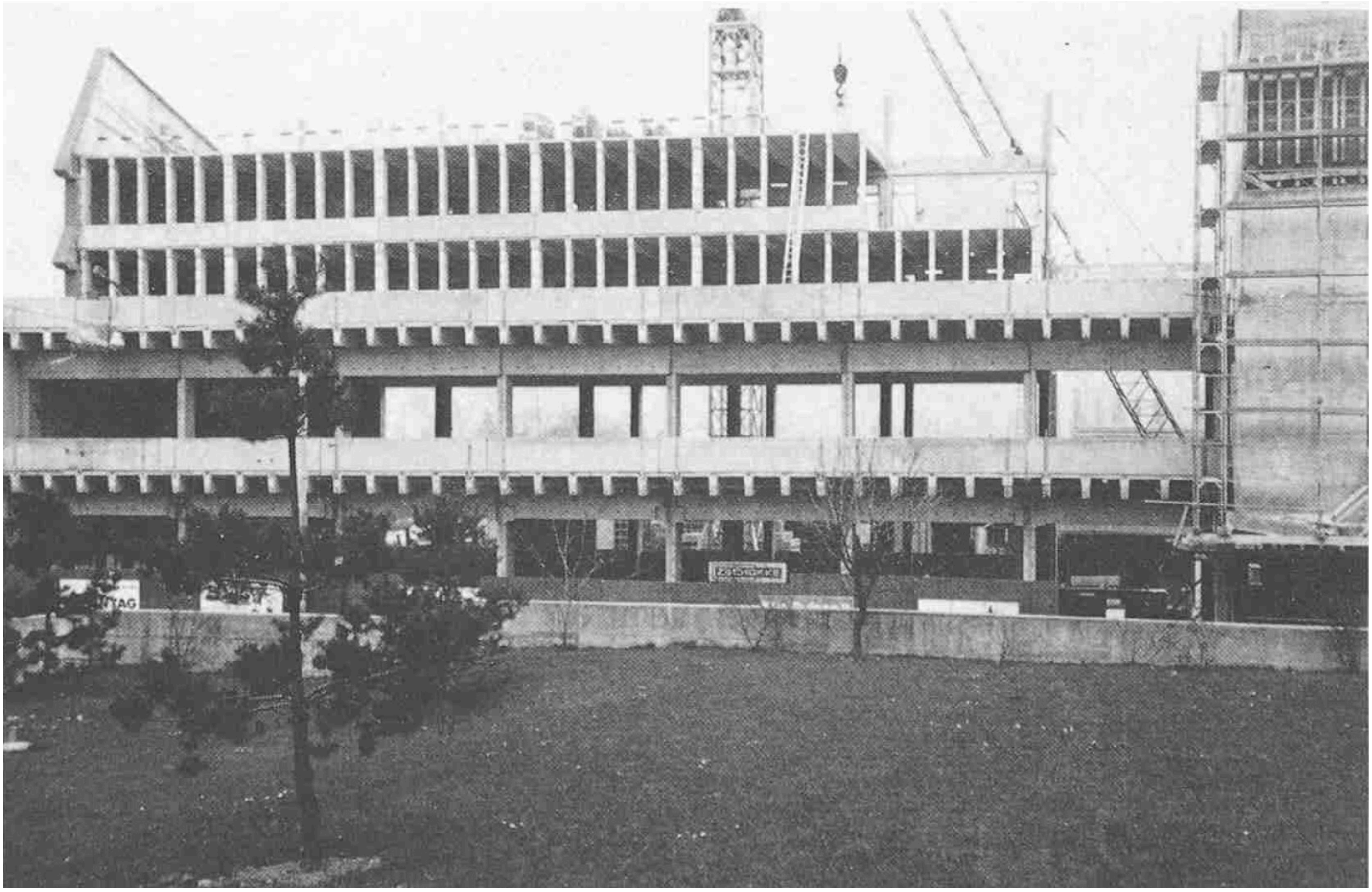


Aesthetic concerns arose as certain components aged. The building's facade, which initially showcased the active solar technology, eventually lost its purpose with the deterioration of the system behind.

In this context, the Micafil building could be seen as an example of how companies sometimes prioritize a presumed image of technological progress, driven by marketing and advertising, over the actual environmental impact. The Micafil building appears to have sacrificed energy efficiency in favor of choices that are more in line with active technologies, essentially creating a corporate showcase.

The structure

stripped of its covering, does not appear to be designed for solar architecture.



It is made of 8,700 tons of cast-in-place concrete and 5,500 tons of prefabricated concrete, consisting of a total of 2,400 elements, including ribbed slabs specially designed to facilitate the integration of systems.

It is modular and easy to assemble. It was conceived with emphasis placed on the speed of construction, using dry finishing techniques with the goal of minimizing occupancy times. This allowed for efficient project completion.

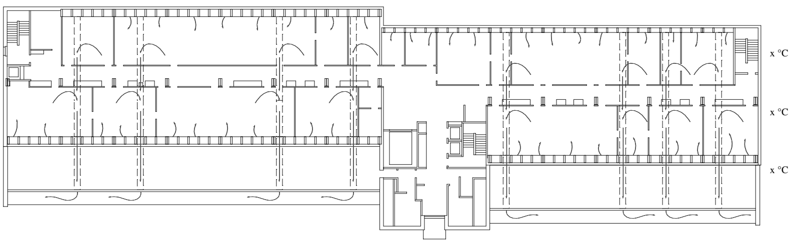
The building's structure was designed with the aim of maximizing the use of available room height, allowing for optimal integration between various installations and the architectural system.

One of the main features of this structure is the large span with a significant load-bearing capacity. This feature provides considerable flexibility in the use of spaces within the building, allowing them to be adapted to specific needs.

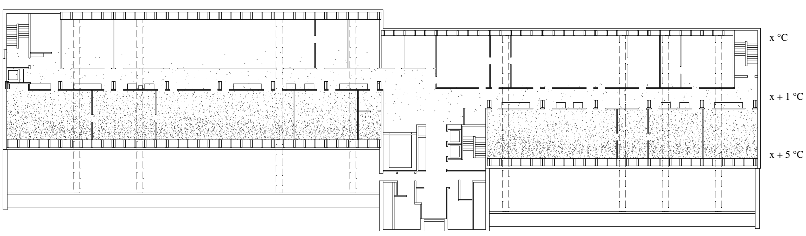
Rethinking the present

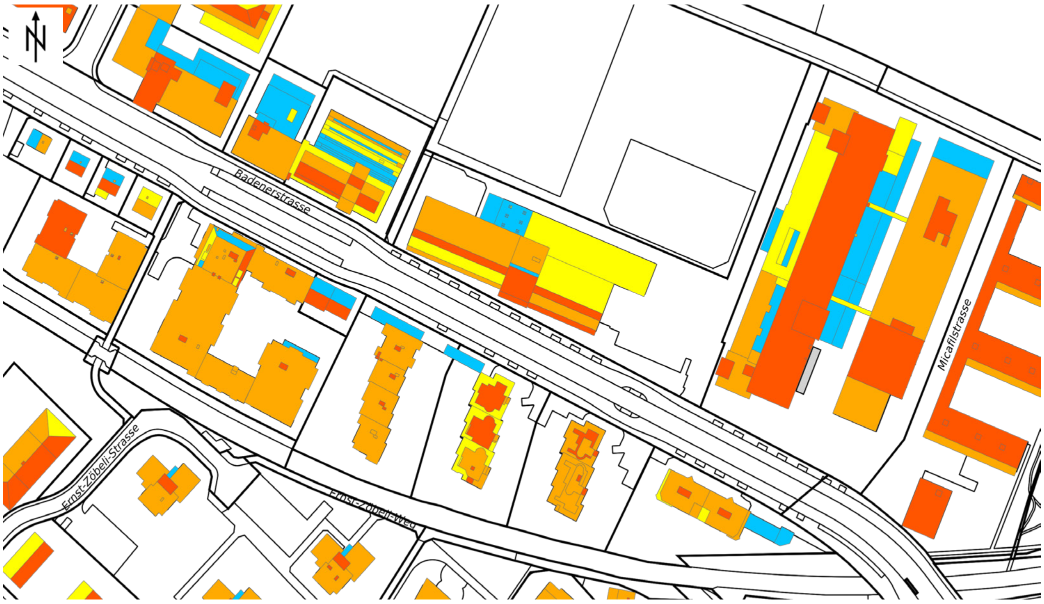
We have a system that no longer functions, whose components have become obsolete, risking to drag the entire building down with it. Nevertheless, there are several positive aspects that hide potential for the building and its area.

1978

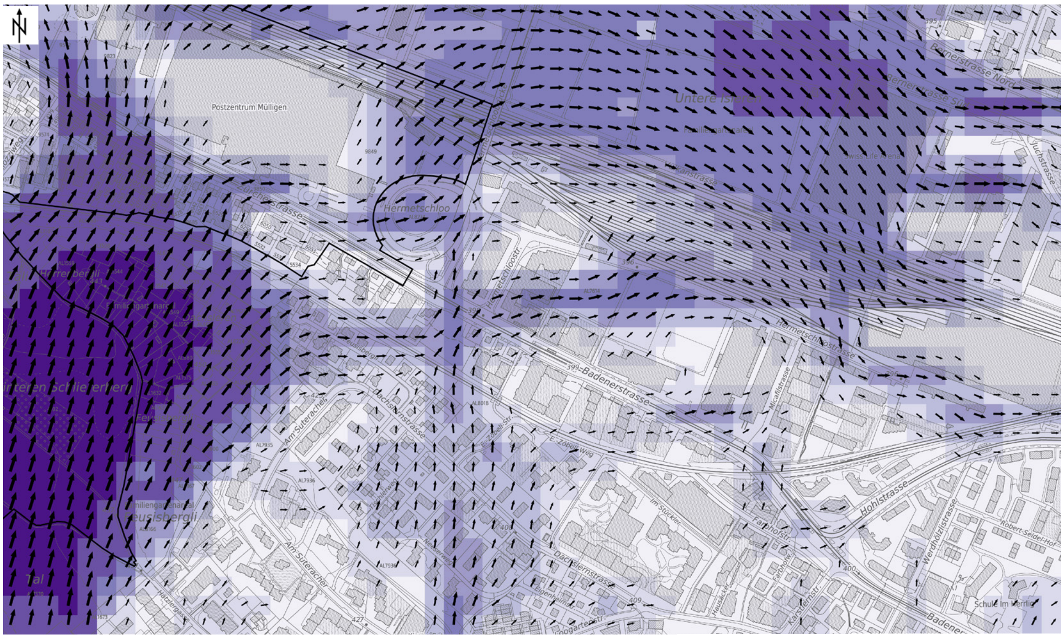


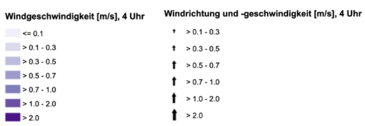
2023





Despite the non-functioning system, the solar potential is quite high. Obviously, this potential decreases in shaded areas due to the building's geometry.

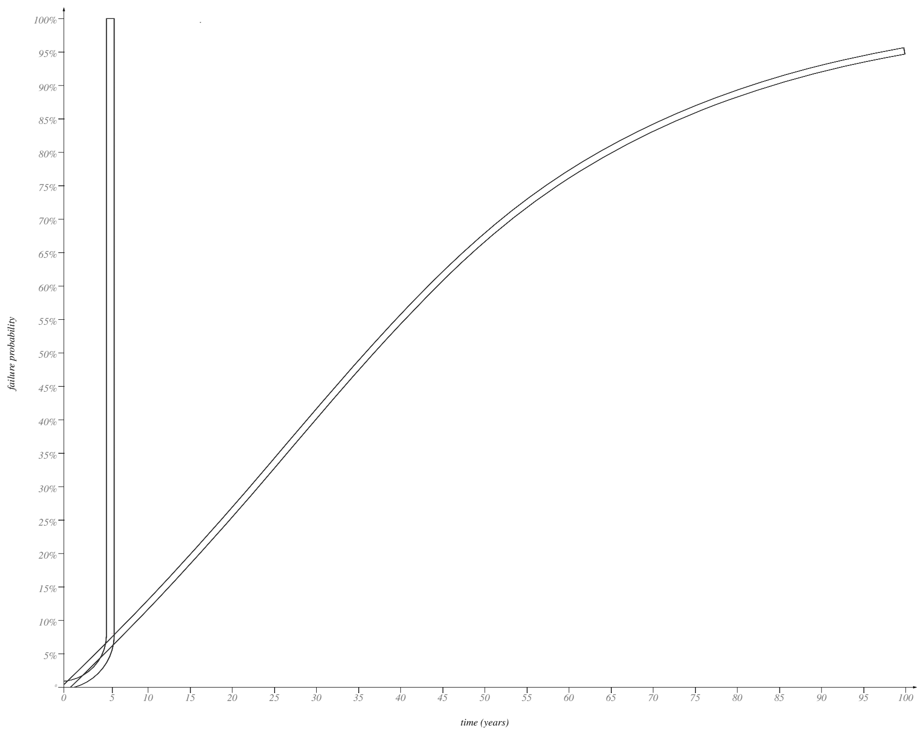


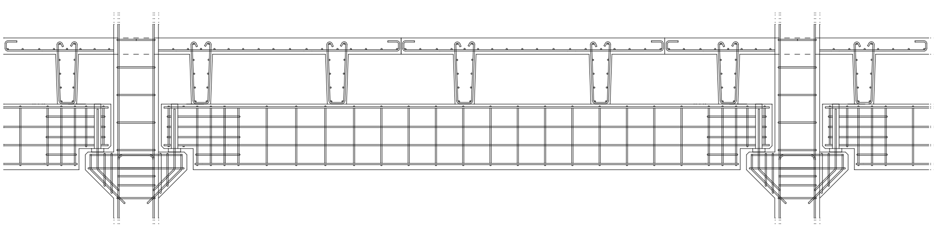


The building's plot is not particularly affected by the wind. This is a good thing because, according to the 7 principles of solar architecture by Sabady, the less the influence of the wind, the better the conditions for a project based on the sun. This is because a windy area could negatively impact the energy production of the building.

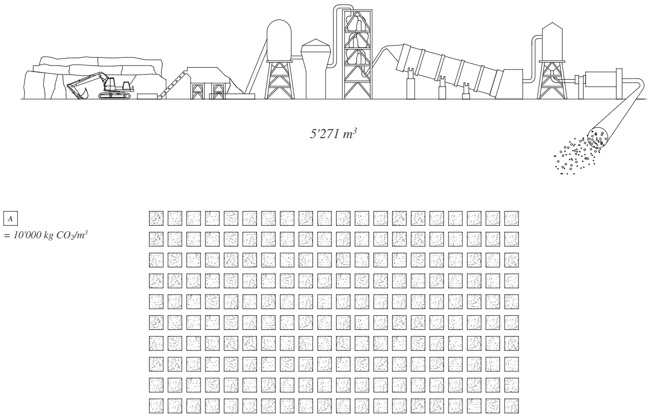
Despite being designated as a high-potential residential area in the urban plan, the peripheral zone should not undergo significant changes in the near future, ensuring the continued opportunity to work with the sun.

The likelihood of failure of cement increases very slowly compared to its operational lifespan. Since the Micafil Maschinenfabrik is based almost entirely on prefabricated concrete elements, its lifespan is rather long. Furthermore, in terms of energetic means, concrete has the potential to be used as a battery due to its very high heat capacity.



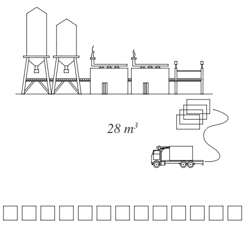


Concrete



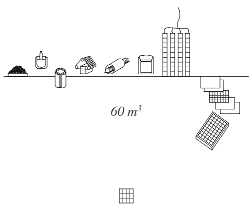
2'022'286 $KgCO_2/m^3$

Triple glazing



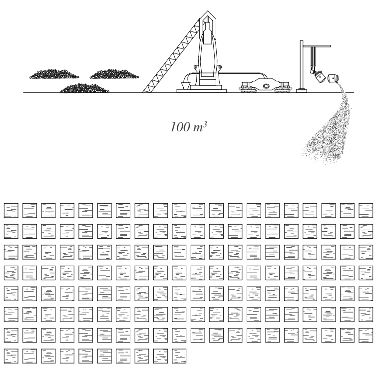
130'816 $KgCO_2/m^3$

Solar collectors



12'420 $KgCO_2/m^3$

Metal



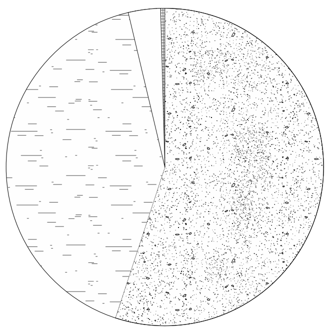
1'520'901 $KgCO_2/m^3$

GHG emissions from the production of materials, especially carbon-intensive ones like cement and steel, are major contributors to global warming. Reducing GHG emissions of construction materials is a key focus of sustainable construction practices. This involves adopting strategies such as using low-carbon materials, reducing waste, improving construction practices, increasing energy efficiency, promoting recycling and reuse, and choosing materials that have a smaller carbon footprint over their life cycle.

This building has a very high amount of CO2 released into the air per cubic meter in relation to the material. Despite this data being alarming, it can seen as something that could stimulate the birth of innovative ideas in ecological terms. In fact it is very helpful in understanding the importance of preserving its various components, trying to reuse those parts that are in a state of obsolescence or imagine how other elements can be activated/reactivated differently.

Triple glazing = 3.5% Solar collectors = 0.3%

Metal = 41.3%



Concrete = 54.9%

total embodied emissions
3'686'423 $KgCO_2/m^3$

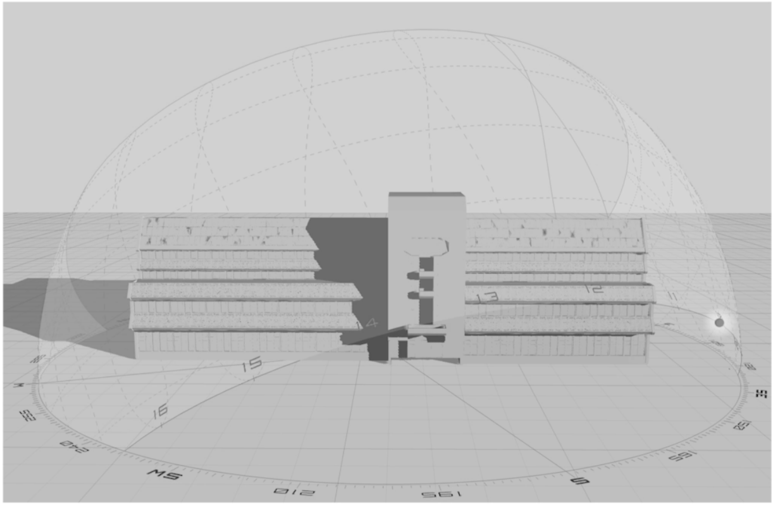
How can an architectural language of energy address the problem of obsolescence?

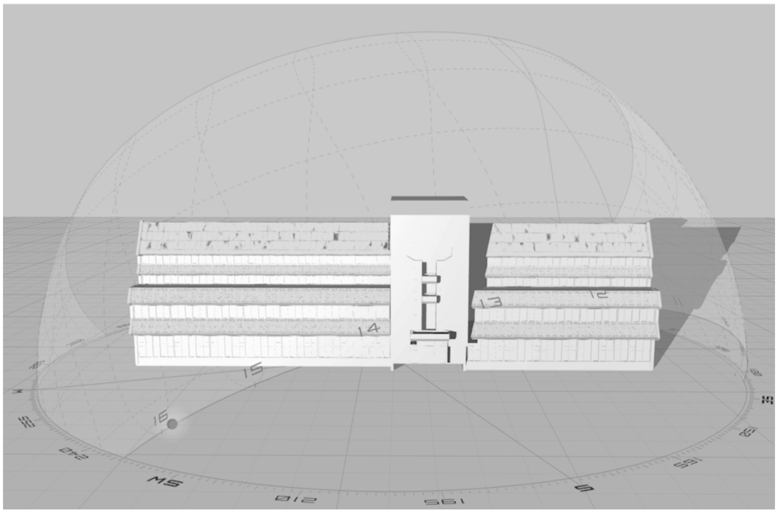
Where does the boundary between active and passive technologies lie?

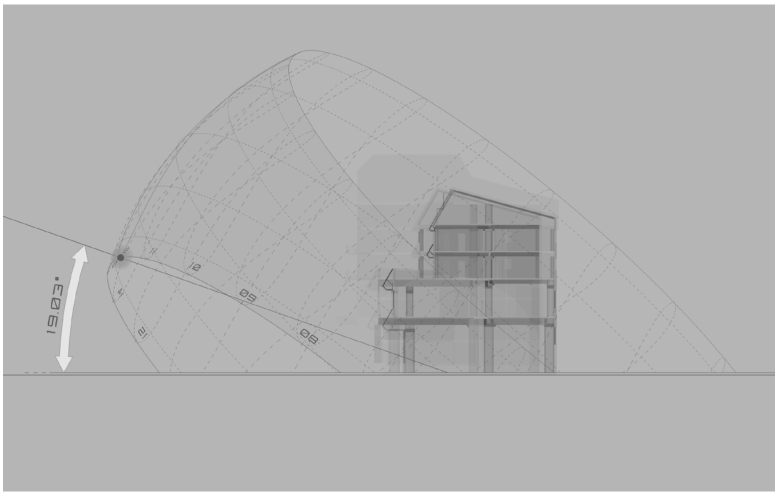
Can we restore the original envisioned value of a building through its refurbishment?

Shadows projection

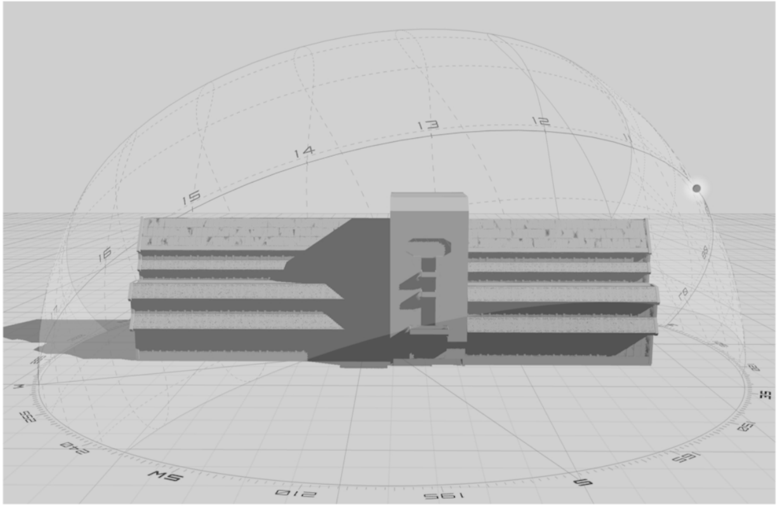
winter

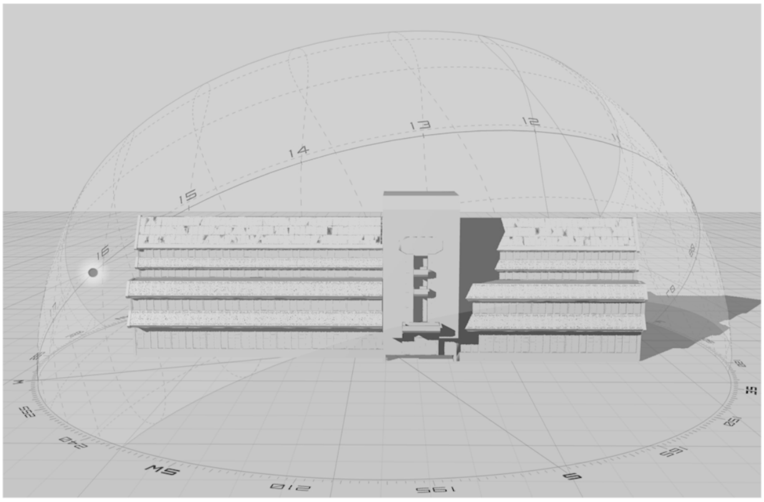


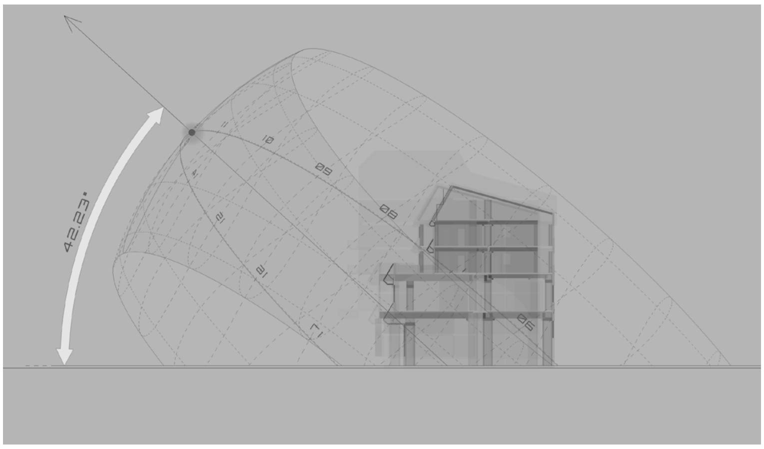




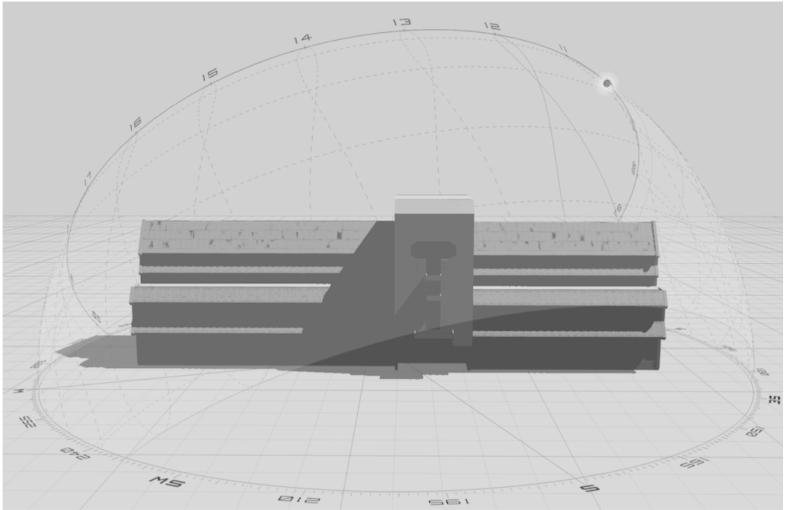
autumn/spring

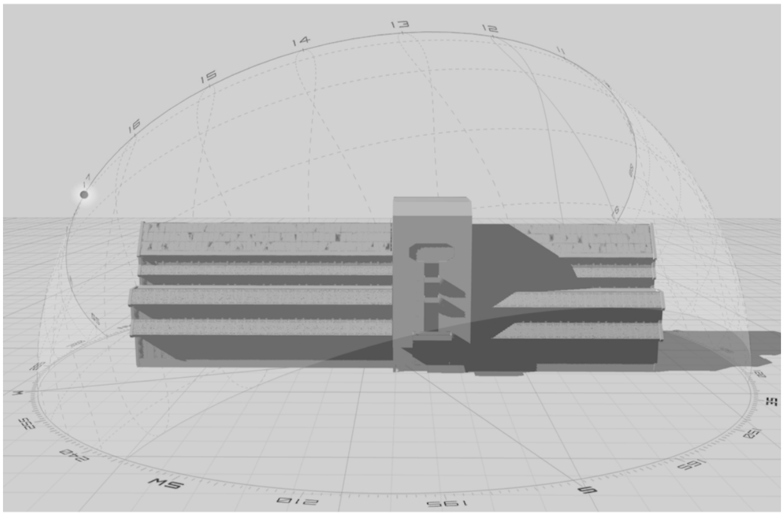


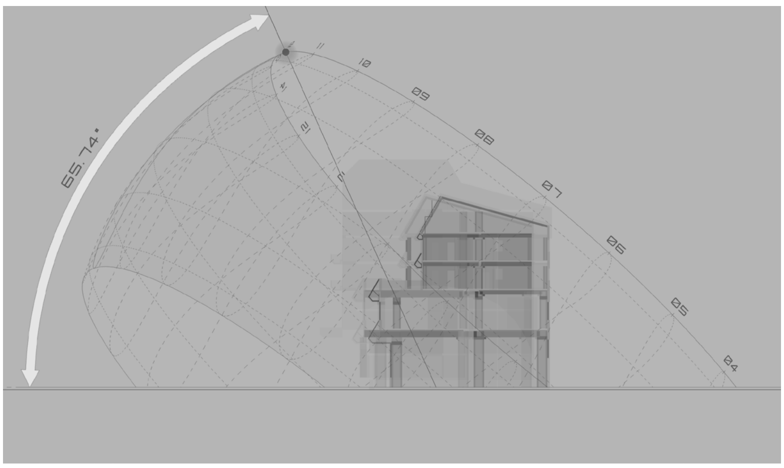




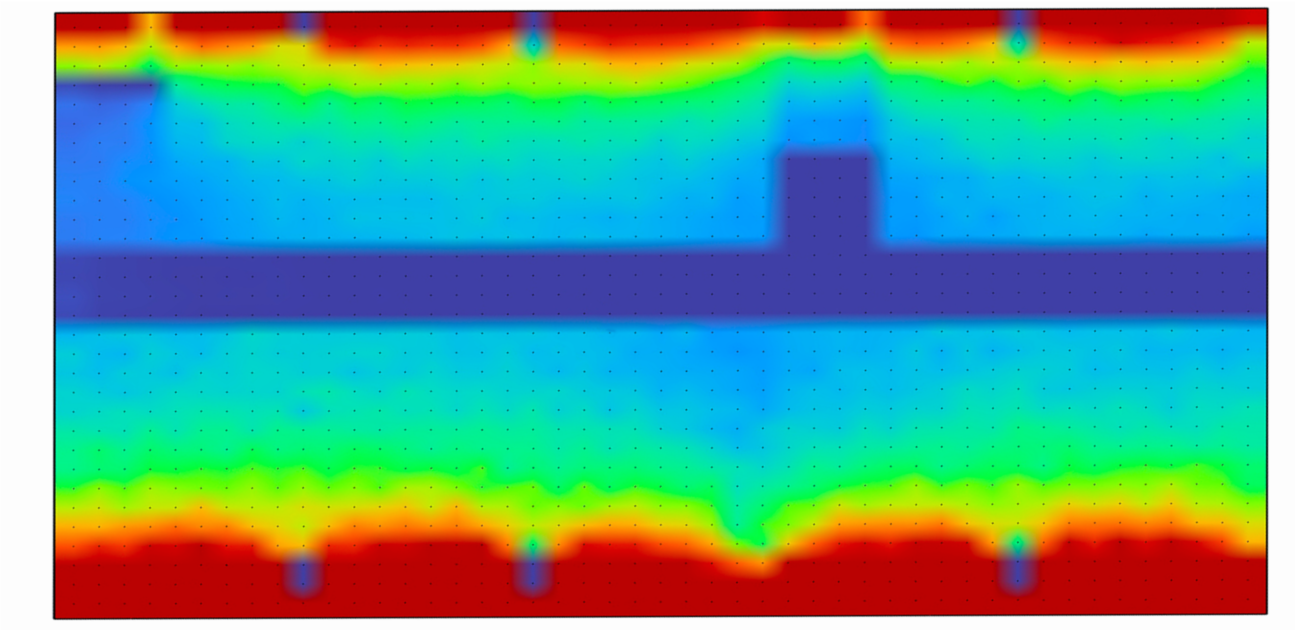
summer

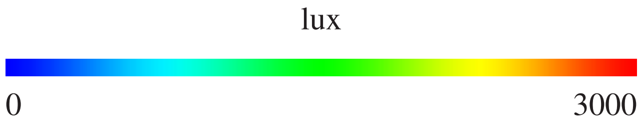


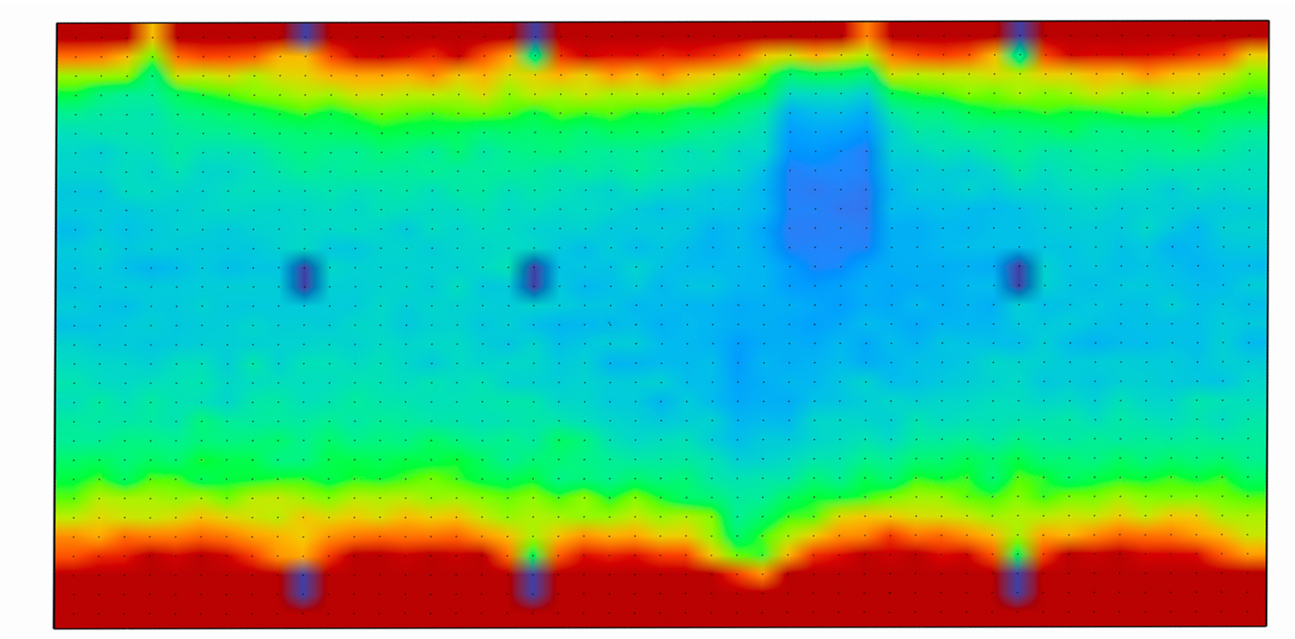


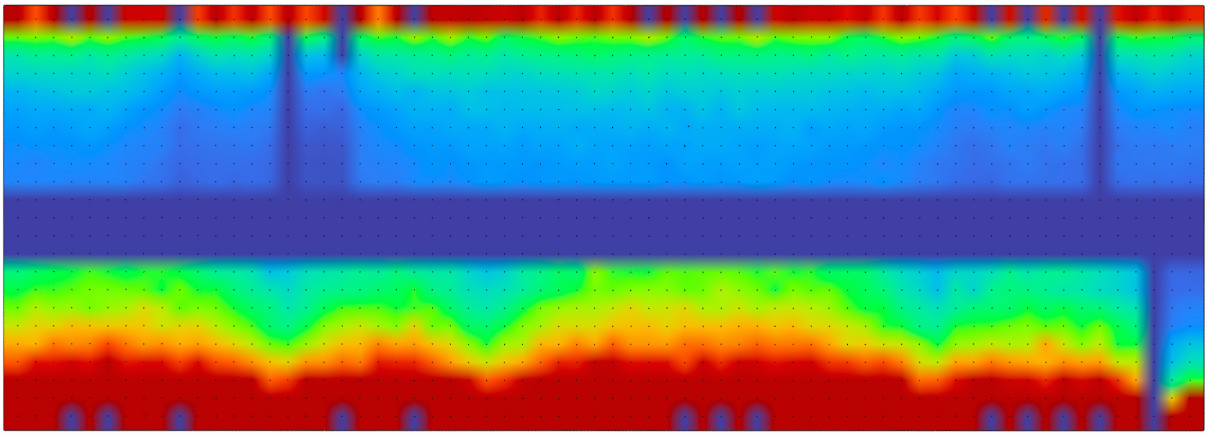


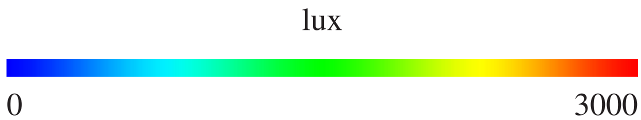
Mean illuminance







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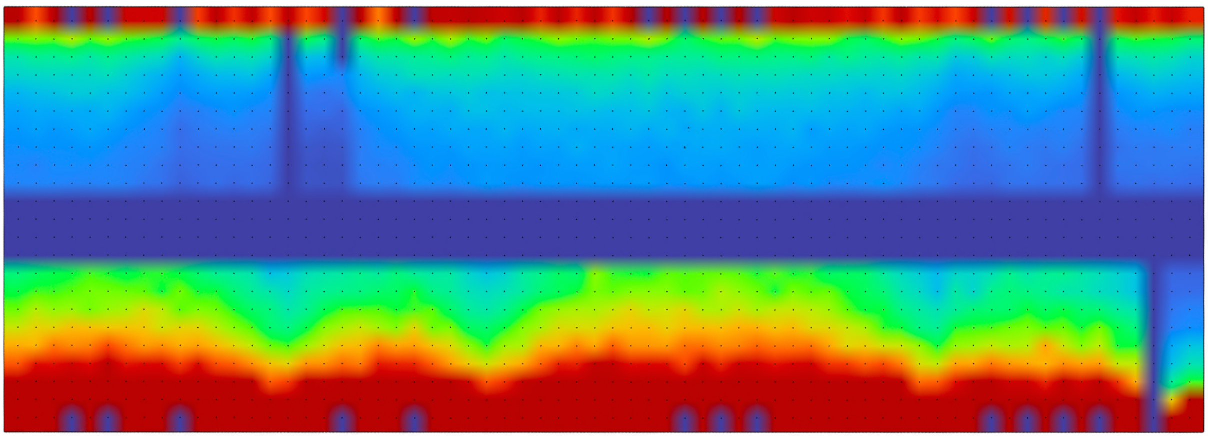

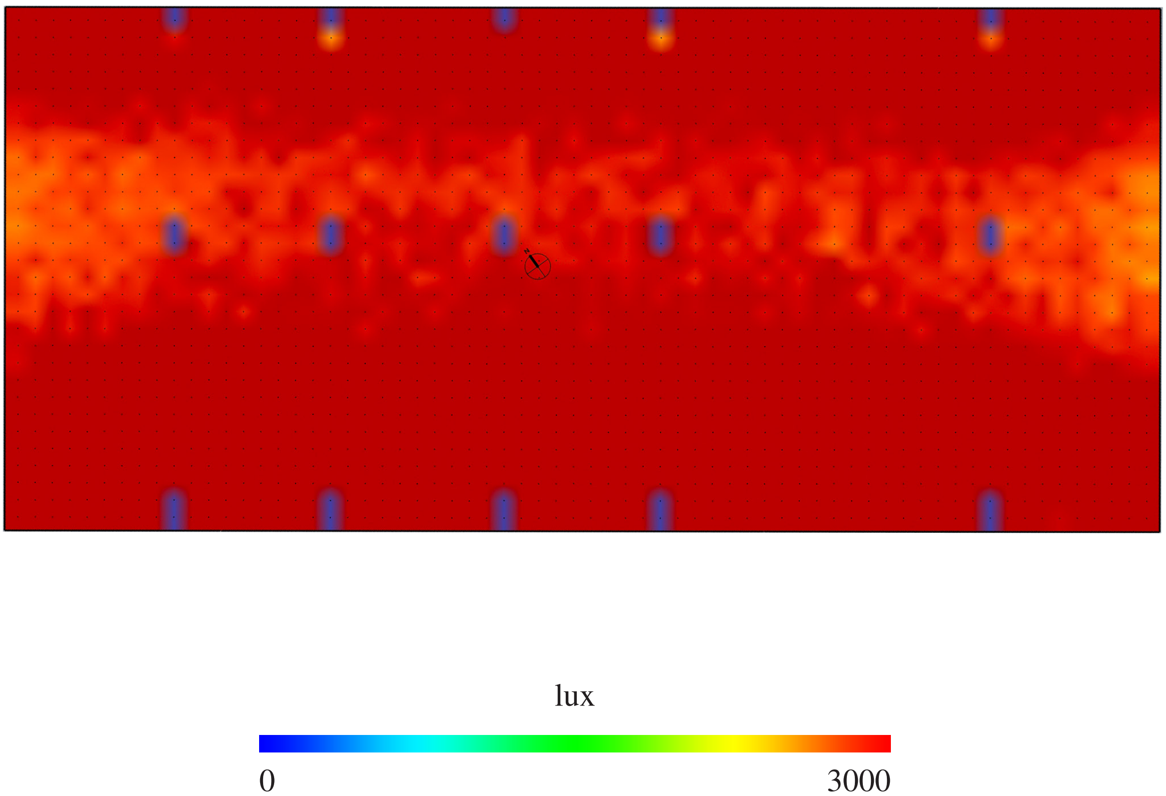
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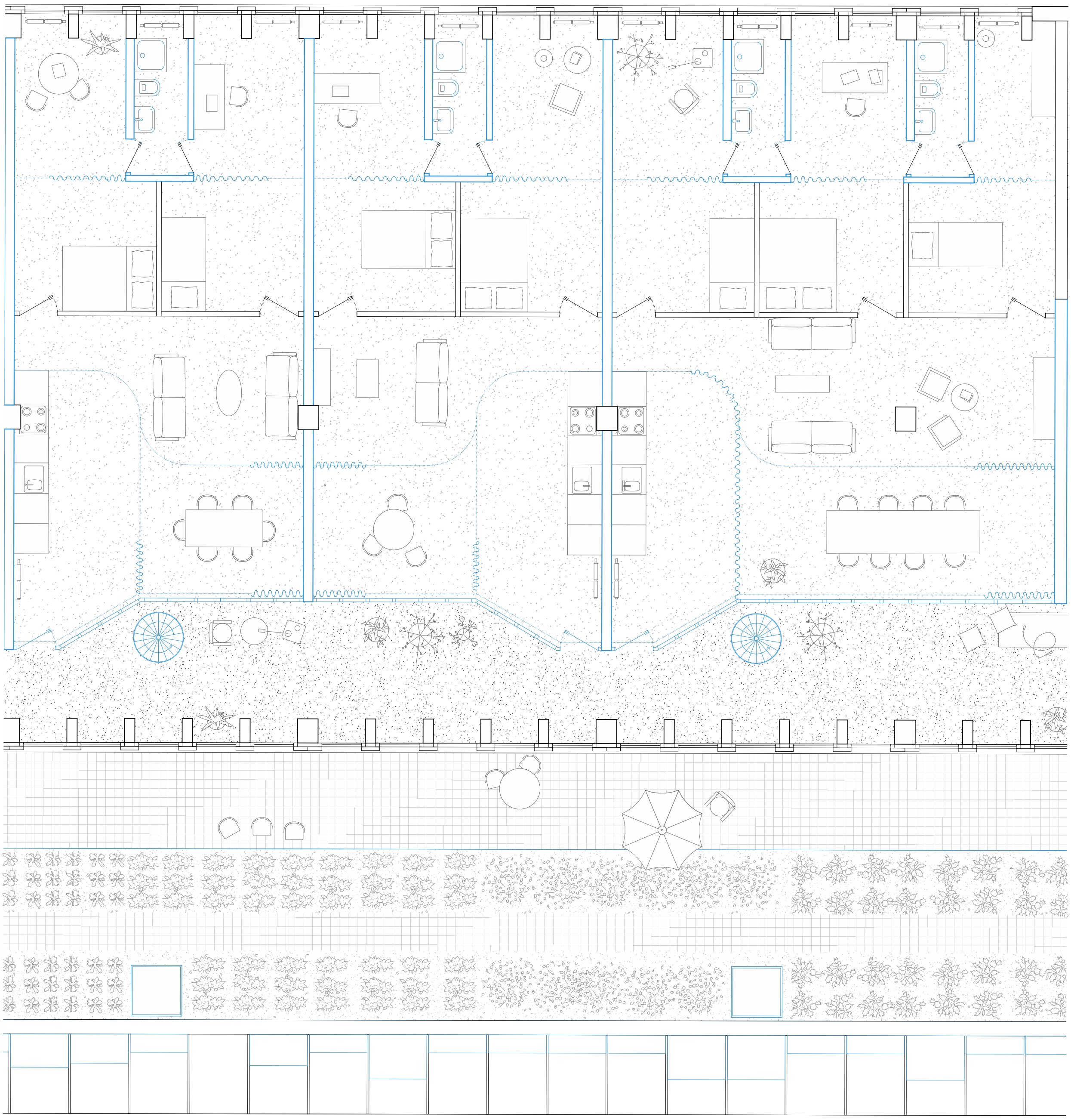
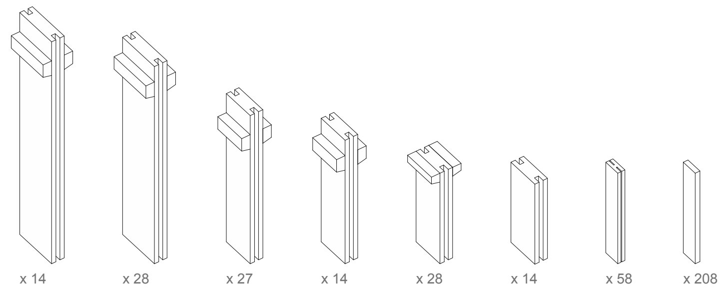
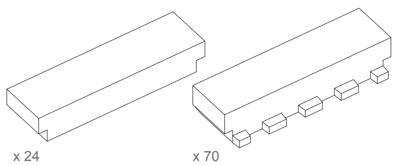
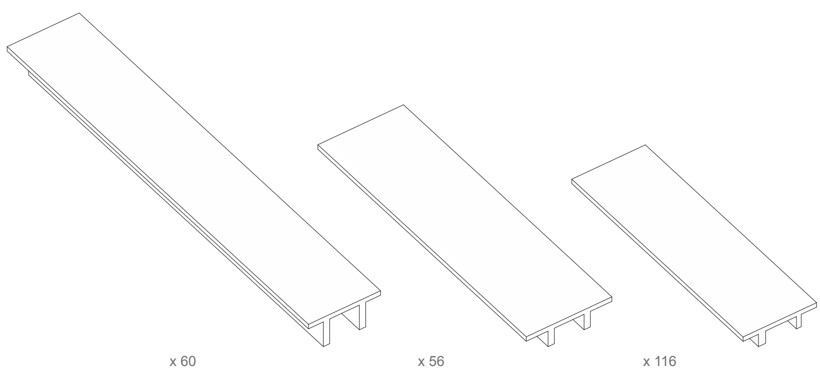
Adaptation



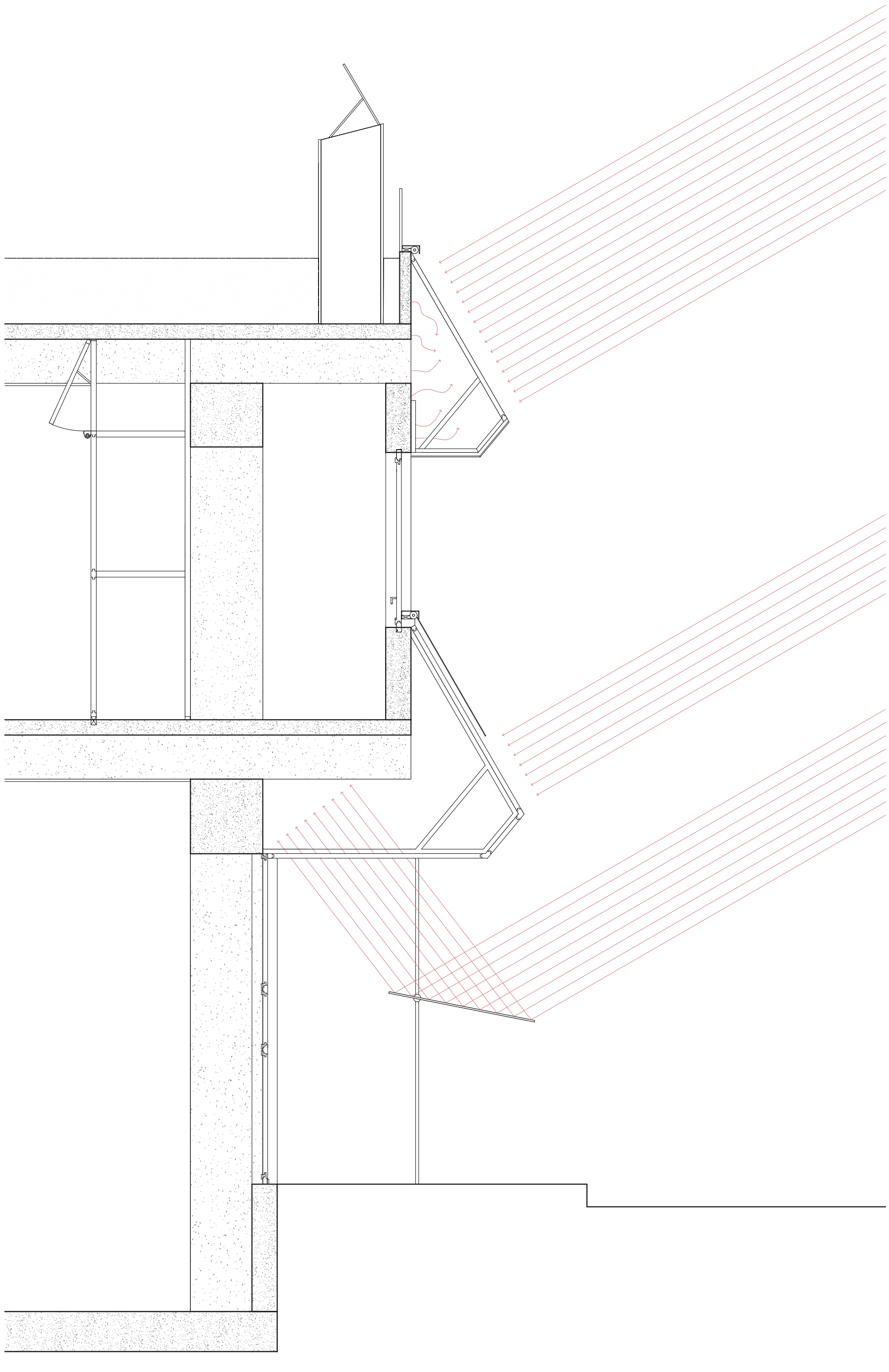
Components as thermal mass



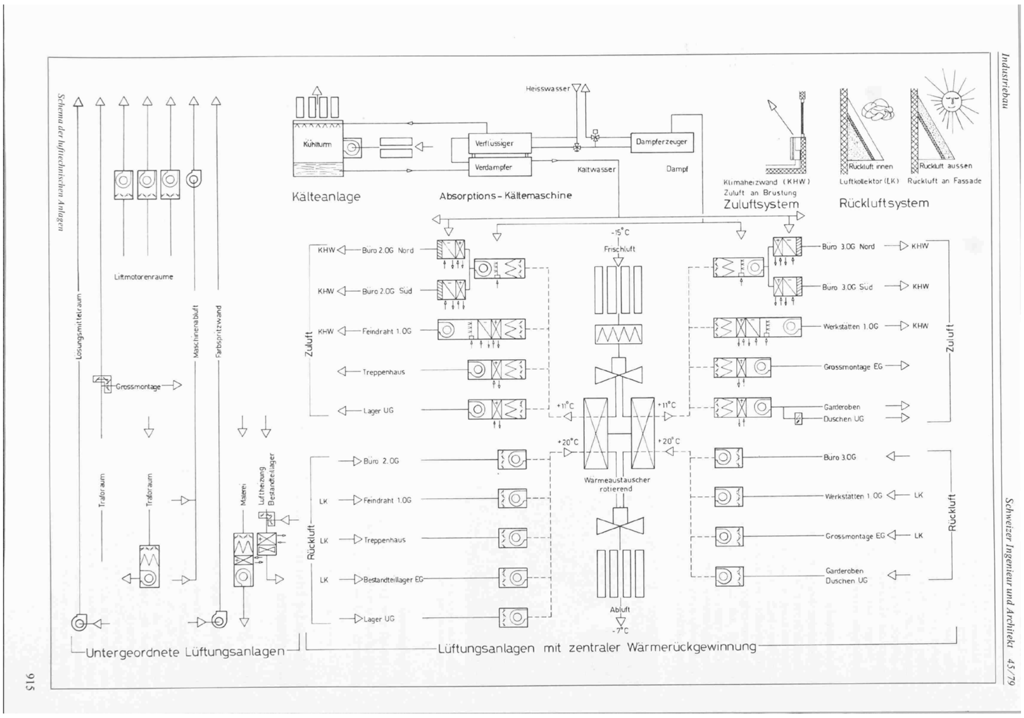


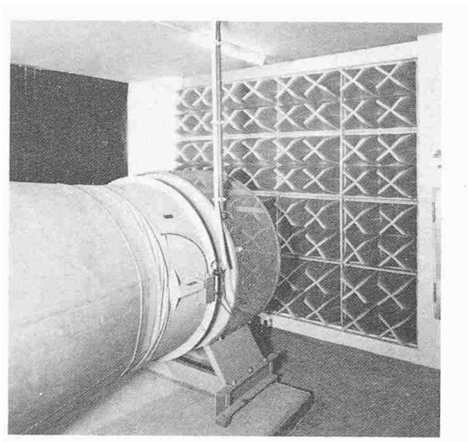


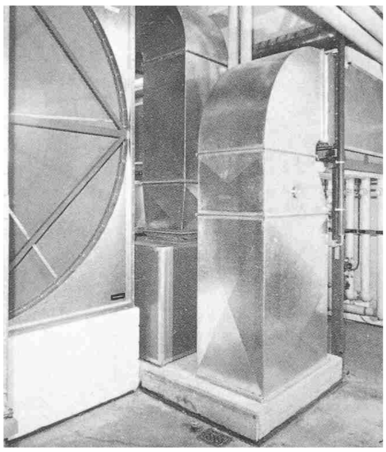
Adaptation



Old ventilation system







Adaptation