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COURANT D‘AIR

MASTER THESIS
HS22

NOSTALGIA
ECOLOGY

JOËL SCHMID

COURANT D'AIR

The research which brought about the following project studied the question of the air flow in the Bürgerhäuser. This circulation helps to keep the inside of the house at a comfortable temperature all year round. Thanks to the materials used in the construction of these houses (which is mainly stone masonry), the air coming from outside is tempered before reaching the living areas on the upper floors. Furthermore, each room has a dual connection, which allows for the air to continuously flow throughout the rooms.

To begin with the project I'd like to introduce my site. Situated between Bucheggplatz and Oerlikon train station, the tunnels' exit form a trench which cuts right through the neighborhood. On the left hand side (the north) there is the former industrial area of Oerlikon followed by a residential neighborhood up to Bucheggplatz. The area is however split in two due to the growing train traffic of the last century. There are three tunnels coming out of the ground at this point, which makes the trench wider and deeper every time a new one is constructed (the last one was built between 2010 and 2017).

In this area, one can identify different axes which I'd like to show using historical images.

The first axis concerns the tunnels and by extension the trains. Even though it might seem like an infrastructural part of the city that serves only the transportation purpose it was designed for, it could also have thermic potential, as for every train exiting the tunnels a mass of cold air is sucked up from the underground.

The second axis is perpendicular to the trains and is formed by the bridges that connect both sides. The idea of a bridge having other uses than simply transportation is not a new one, nevertheless the tendency when talking about building over infrastructural areas in Switzerland is to cover it and then build on top just as it was done on the other side of the Wipkingertunnel.

The third axis I'd like to talk about is the air and more precisely the movement of the air inside of the buildings. For centuries chimneys have been used as active exhaust systems, yet the GSW headquarter's building uses a foil as exhaust which helps to ventilate the interior thanks to the pressure difference induced by the wind and temperature difference.

With the project I'd like to take advantage of those three axes and emphasize them by seeing the buildings as bridges between the distinct neighborhoods. Thanks to the intervention an exterior square is created but more importantly the buildings reconnect the neighborhoods by being a continuous pedestrian street and creating on the ground floor a bridge-like multifunctional space that can be extended outside into the existing neighborhoods. With this mixed-use of the ground floor, the offices downstairs and the apartments on the upper floors the new neighborhood fully takes part in the existing urban fabric without completely forgetting about the tunnels and the trains

Each building is conceived as a bridge. The height is determined by its structural system as well as by the maximal size of the prefabricated pieces for the transport (20m). Both of the façades let the structure appear through its windows. The South façade is glazed so as to heat the building up and accelerate air circulation in the building. The North façade is wrapped in metallic sheets and its aim is to let in light but at the same time give the inhabitants a certain privacy. The glazed parts of the eastern and western façades visually indicate the entrance of the bridge as a continuation of the street. The entrance to the apartments and offices are placed along the inside street. This leads to the apartments but also to the top floor which is a shared greenhouse that serves as a garden, a common kitchen as well as laundry for the inhabitants.

The tension built between the northern and the southern façade is expressed in the typologies. All the apartments have a connection to both sides allowing an efficient and controllable air circulation depending on the needs. In the section, one can see the air path depending on the season taking advantage of the trains movement, of the cold coming out of the tunnels as well as of the sun orientation. In summer, the hot air generated by the southern façade escapes through the roof and sucks cold air from the train track to distribute it on the different levels of the building. In winter, thanks to the foil attached over the tracks, the low pressure generated distributes the hotter air into the building. The system is also used for night cooling as the heat stored in the building is diffused in the air that climbs up and pulls colder air into the building.

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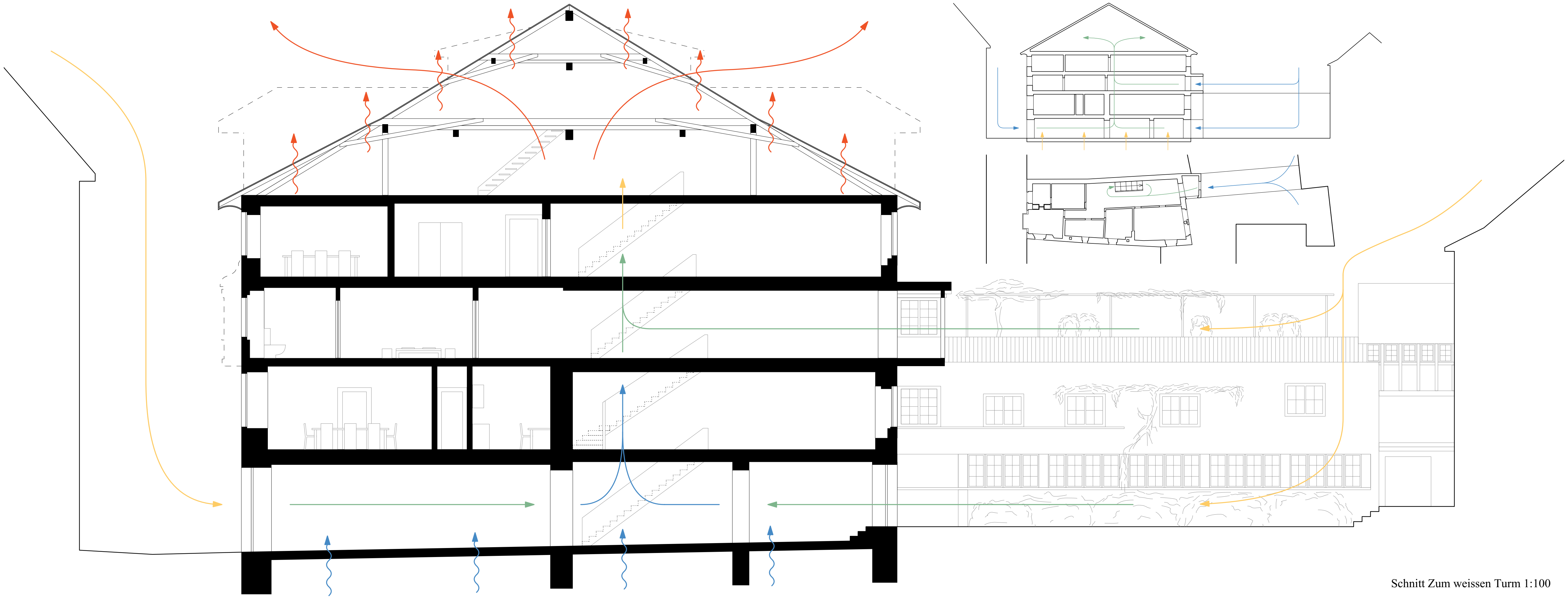
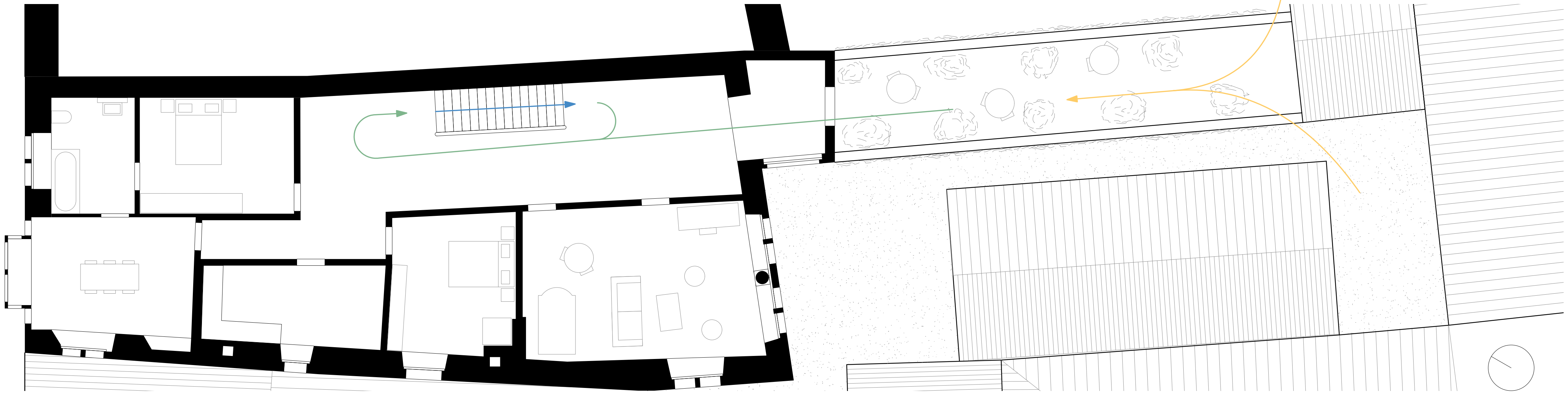
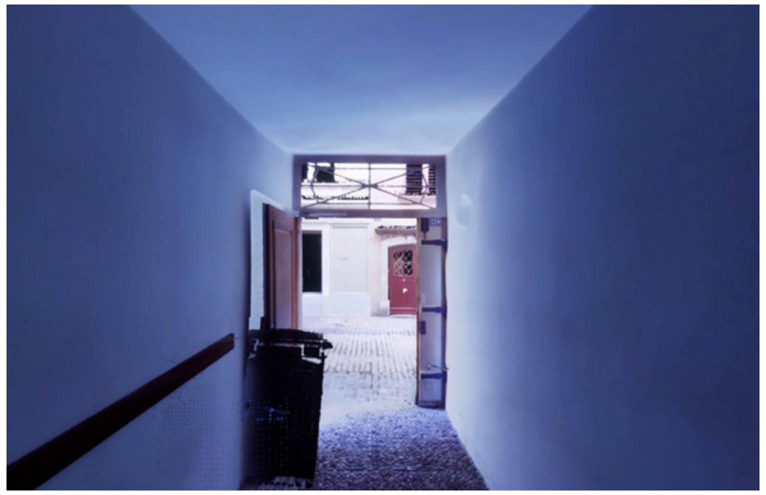


	Luft	Holz	Sandstein	Erde
λ *W/mK*	0.024	1.9	1.9	2
C *J/K/kg*	1005	2300	900	900
ρ *kg/m³*	1.3	500	2500	2000
$\kappa = \frac{\lambda}{\rho C}$	20	0.12	1.18	0.2
$E = \sqrt{\lambda \rho C}$	6	1478	2000	2400

λ : Wärmeleitfähigkeit
C : Wärmekapazität
ρ : Dichte



Matter of air, Drawing study of air circulation in the Bürgerhäuser



Matter of air, Pointcloud animation study of air circulation in the Bürgerhäuser

Original Research Animation

CONCEPT & SITE

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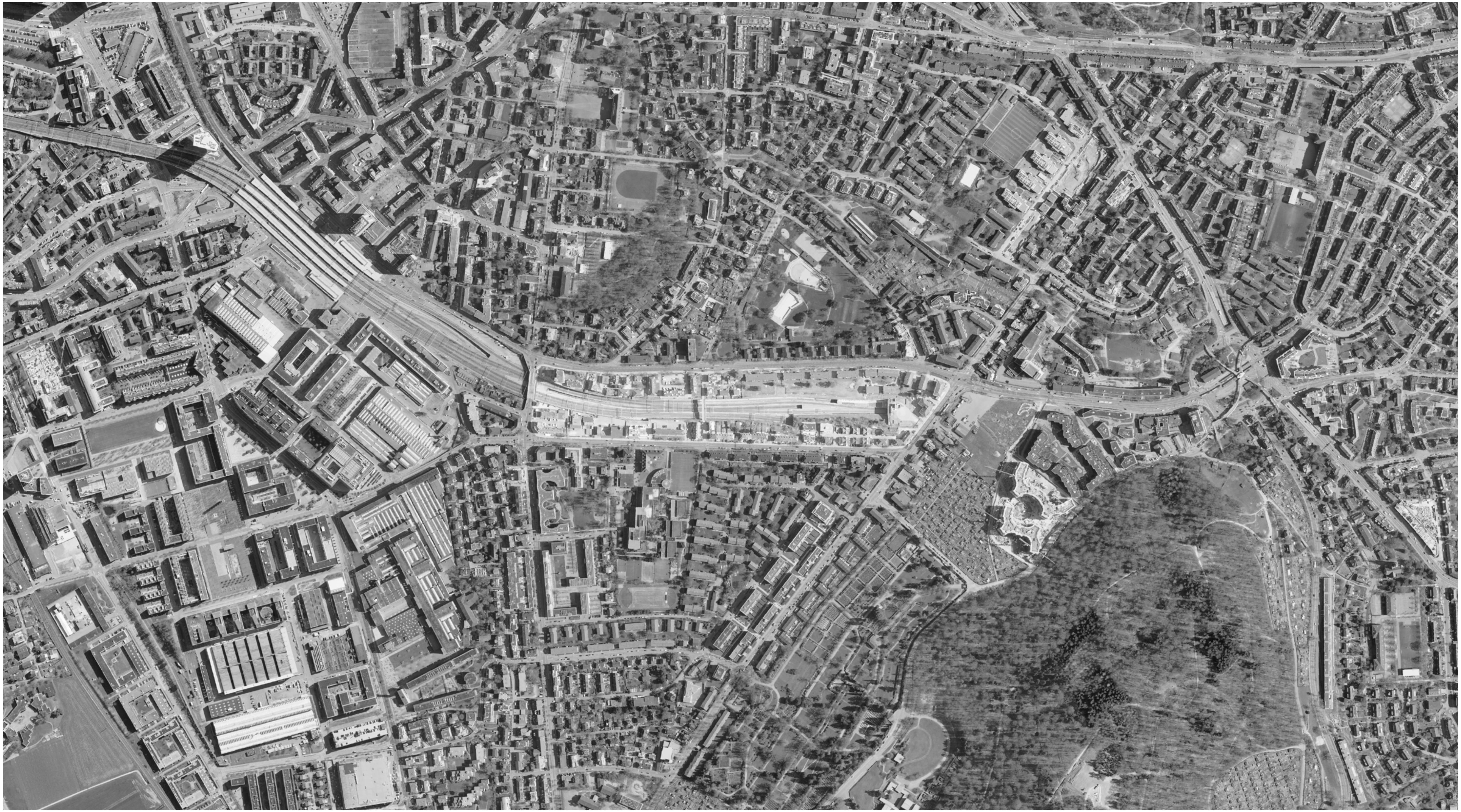
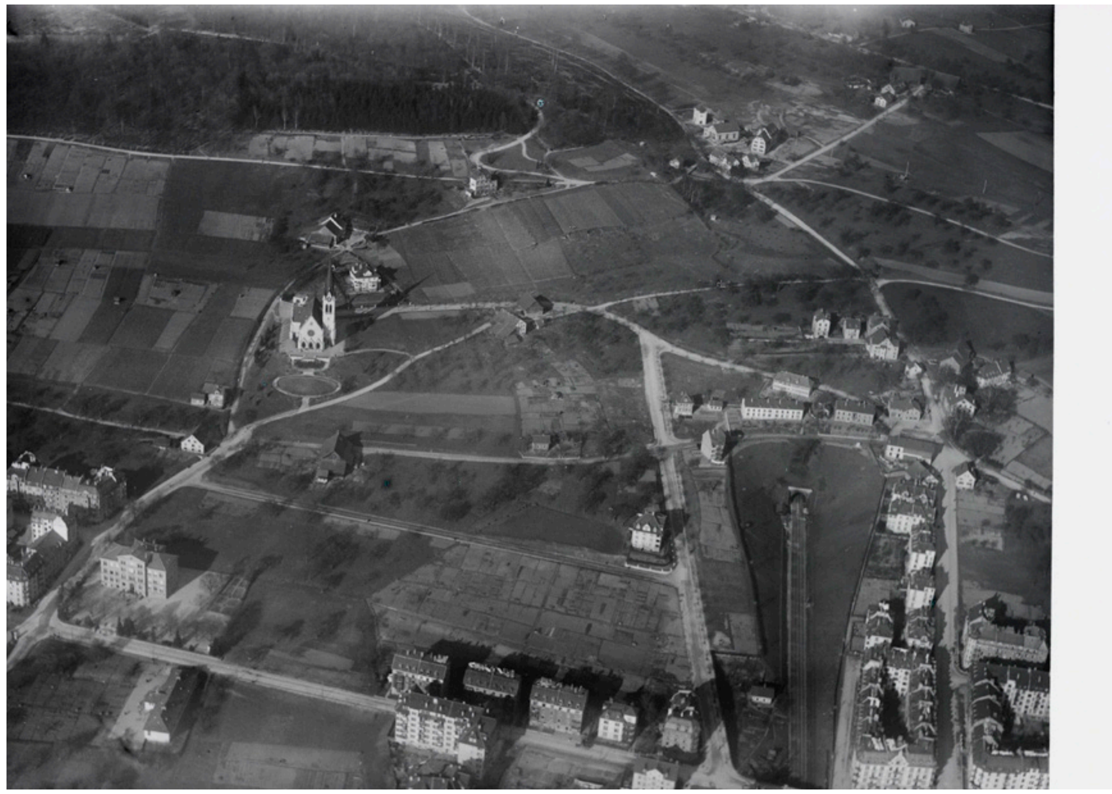


Situation : Between Oerlikon train station and Bucheggplatz

Tunnel dans le Grand Glacier des Bossons, Underwood & Underwood 1901
Storage of cold air in the underground

Zurich-Oerlikon, Wipkinger Tunnel (l.), northern portal, Käferberg Tunnel (r.), Hans-Peter Bärtschi
1991
It might seem like an infrastructural part of the city that serves only the transportation purpose it was designed for

Ponte Veccio, Ingo Mehling 2004
The idea of a bridge being more than a bridge is not a new one



Zurich-Wipkingen, reformed church, SBB tunnel, Mittelholzer, Walter 1920

Zurich, district 10, Wipkingen station, construction site EIWI housing estate above the tracks, Comet Photo AG 1998
the tendency when talking about building over infrastructural areas in Switzerland is to cover it with earth and then build on top.

Zurich Oerlikon, Neu-Oerlikon, ABB site north of Affolternstrasse, MFO high chimney, Heinz Baumann 1995
For centuries the chimney has been used as an active exhaust system

GSW Gemeinnützige Siedlungs- und Wohnungsbaugesellschaft, Sauerbruch & Hutton Architekten 1999
GSW headquarter's building uses a wing as exhaust system

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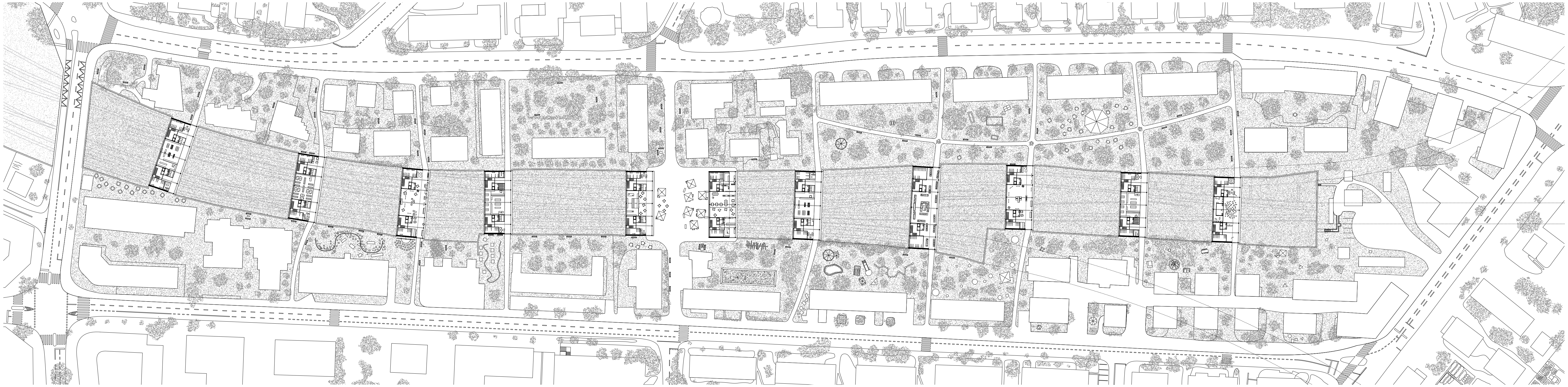
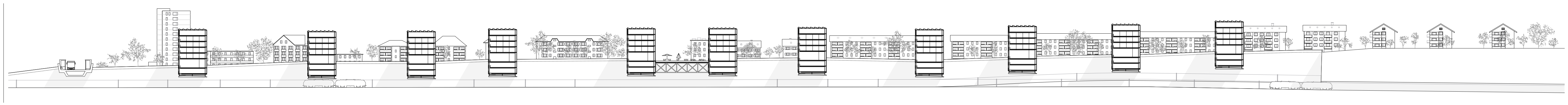

Site Plan


Site Section

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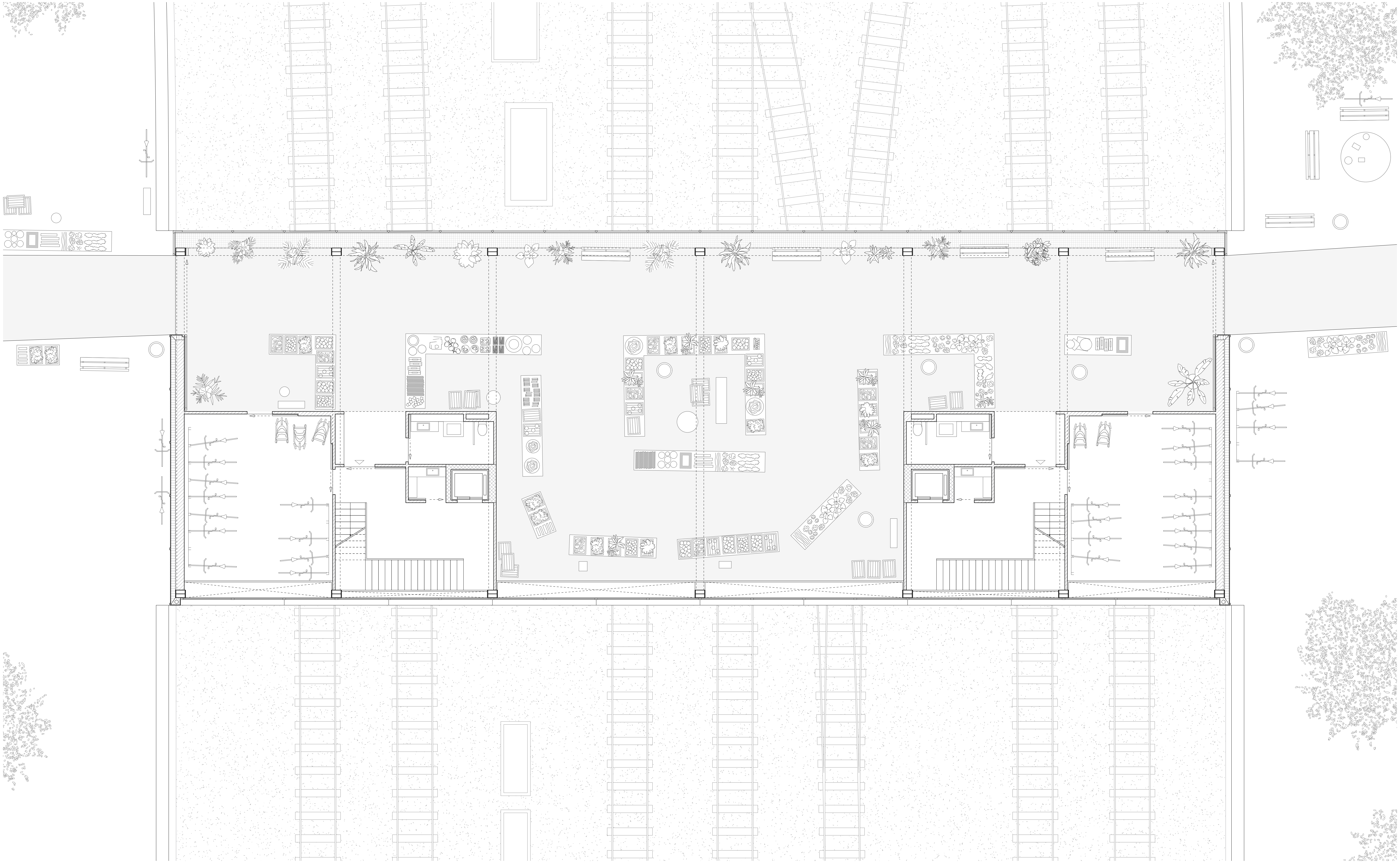

Ground Floor

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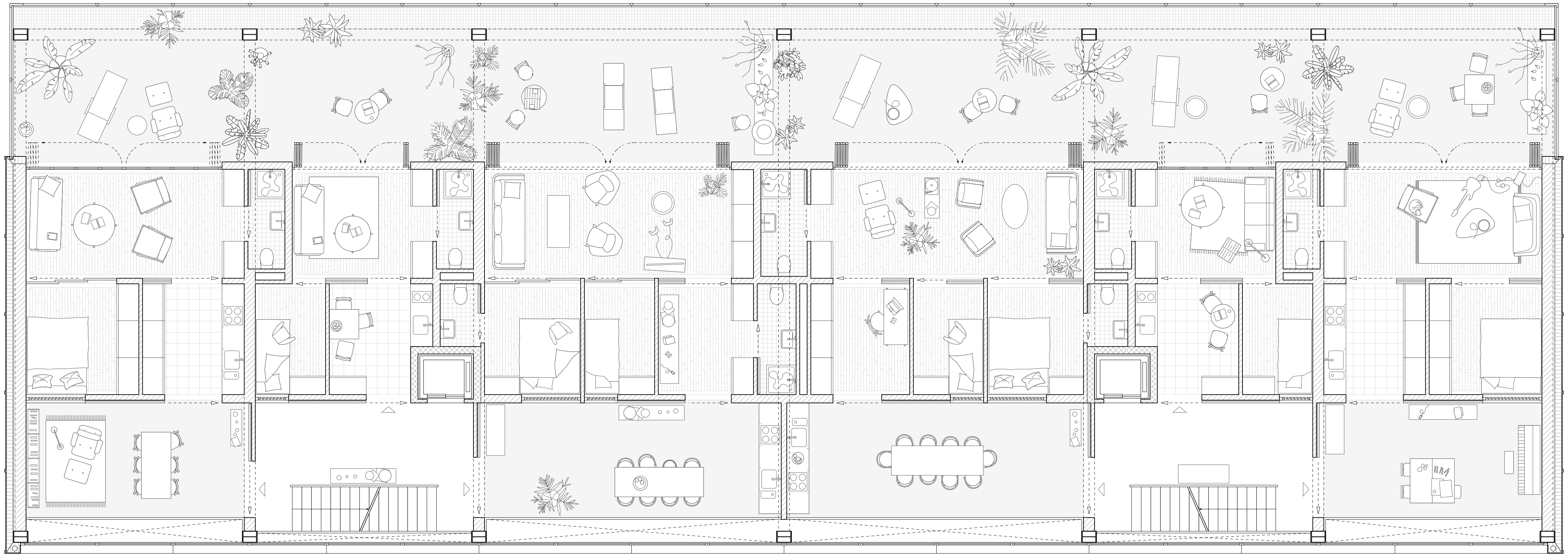
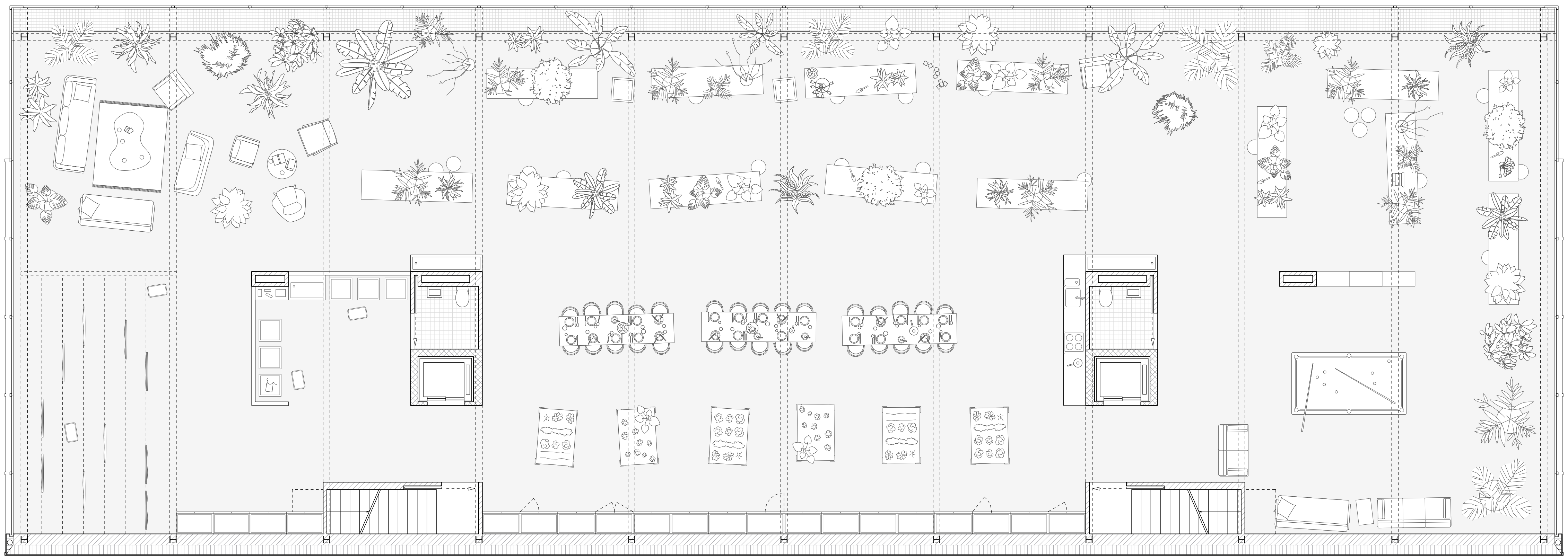


Apartment Floor



Top Floor

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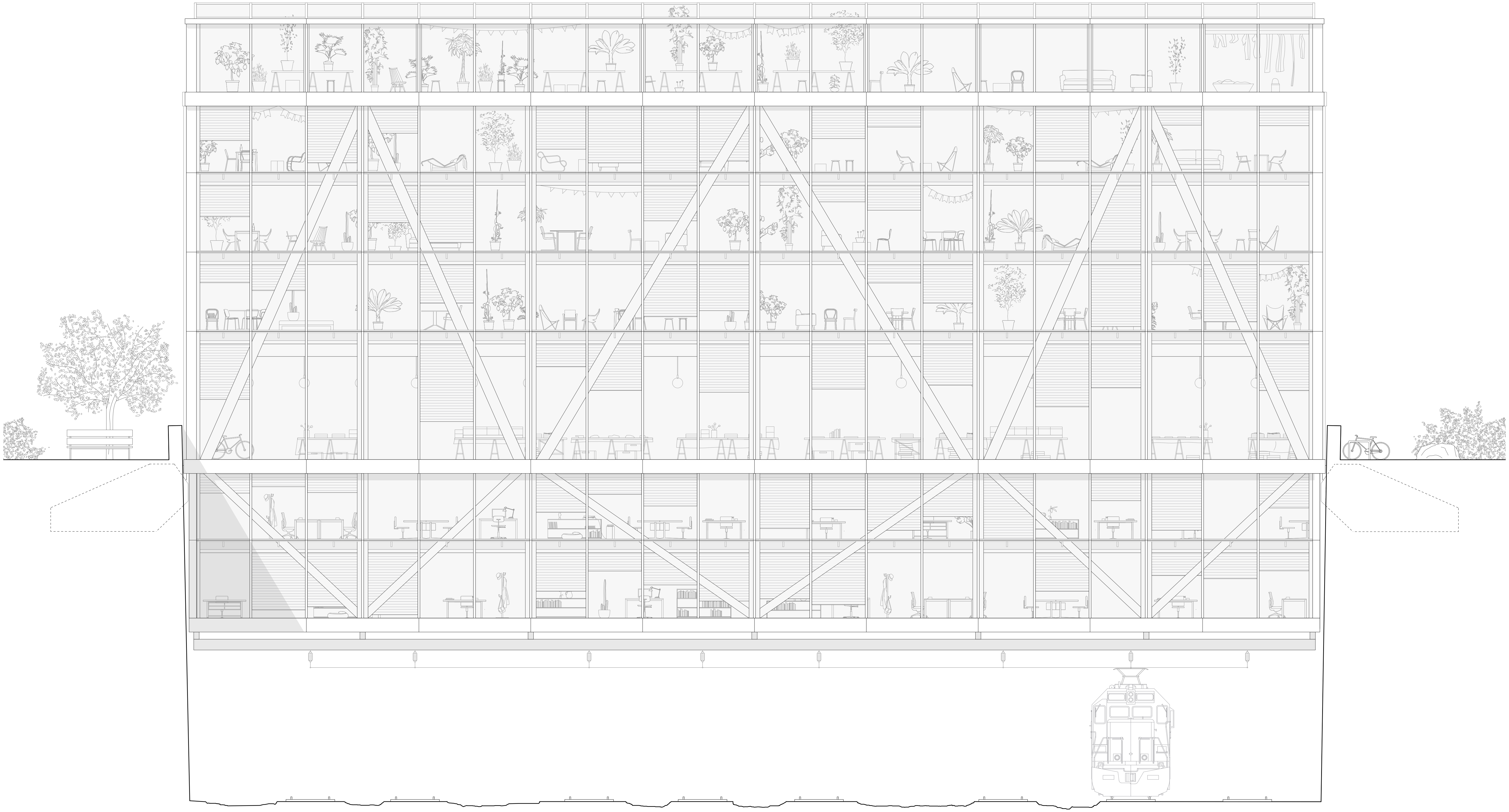

Façade South

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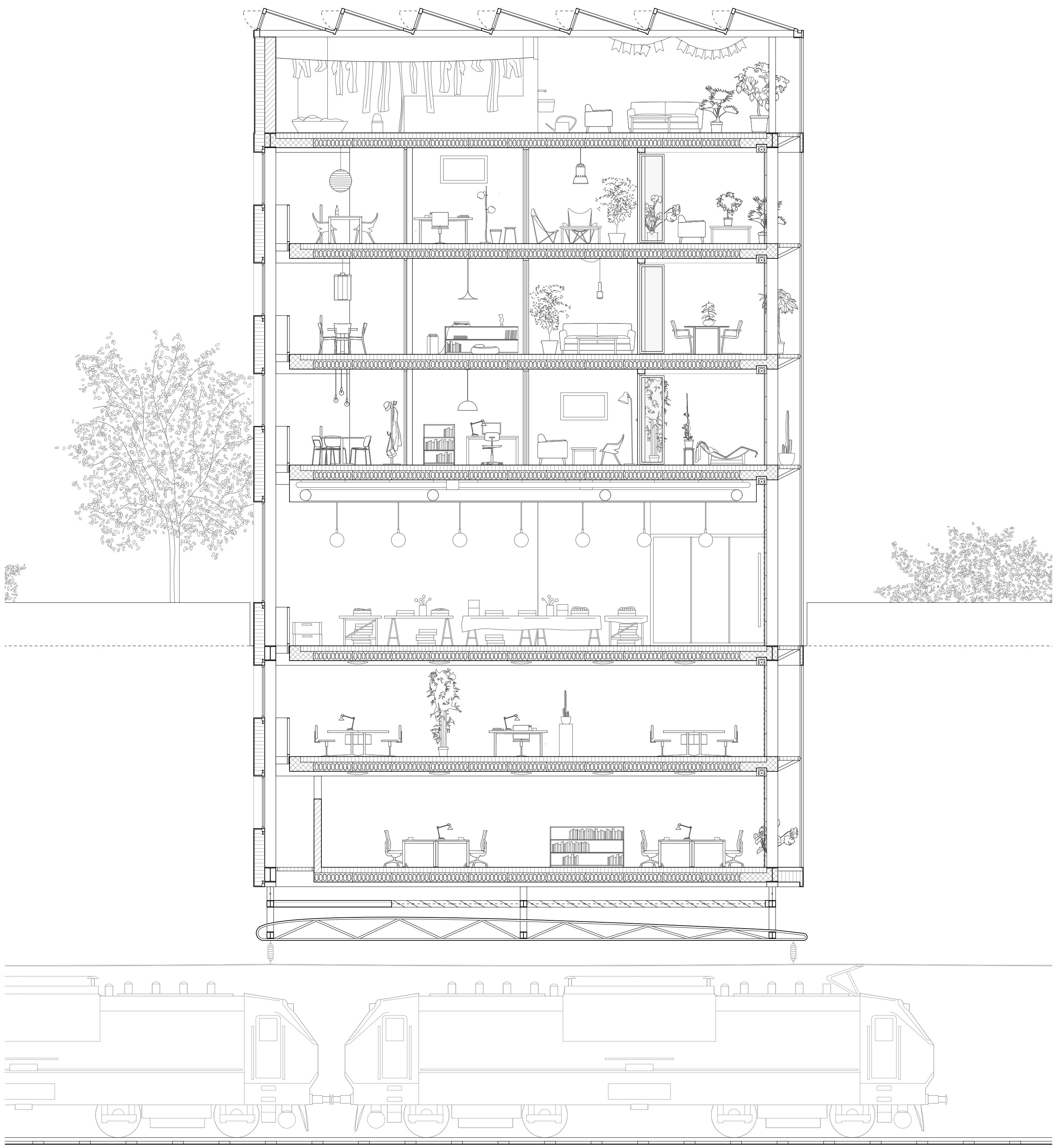
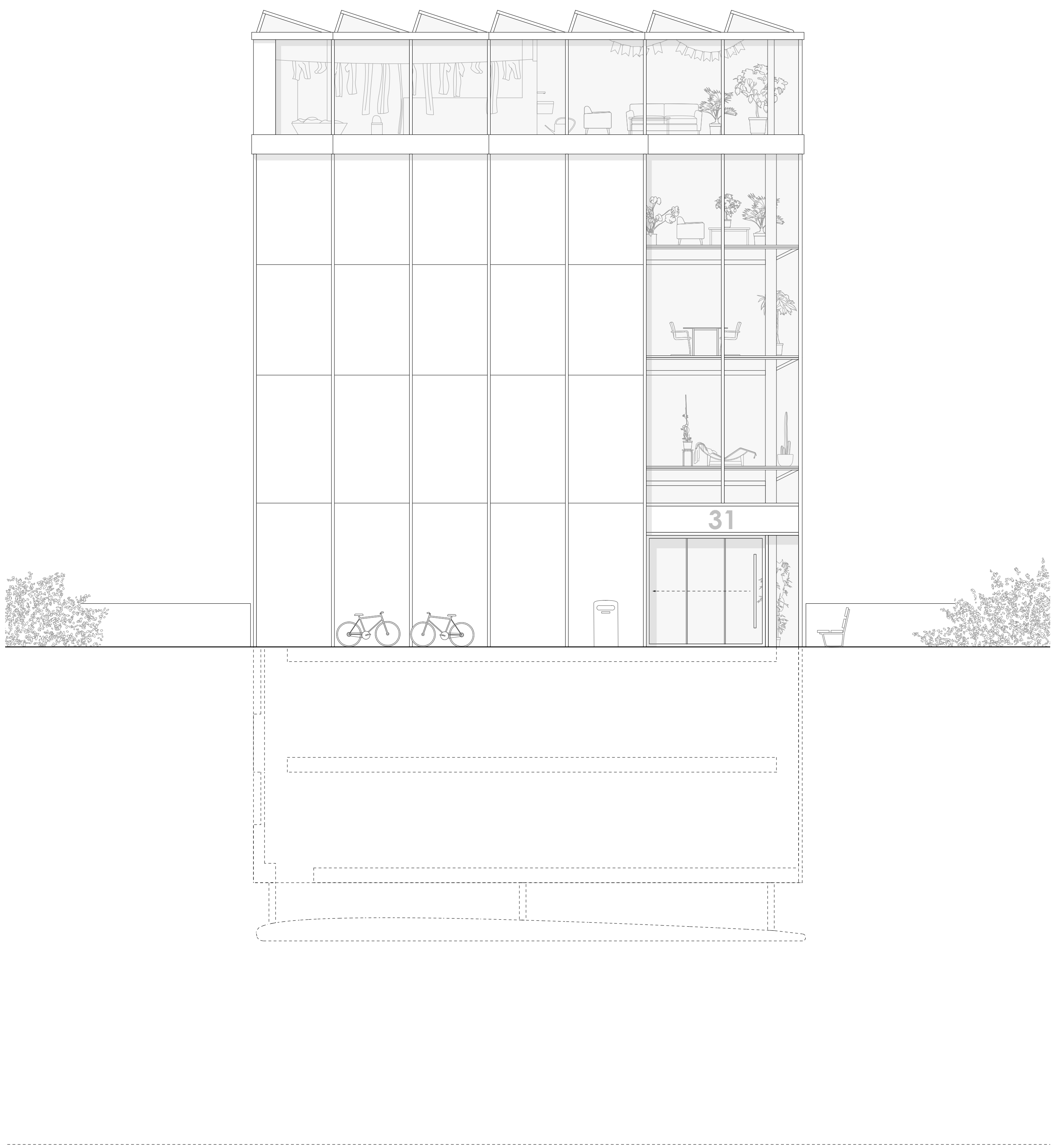
Façade North



Section North-South



Façade West

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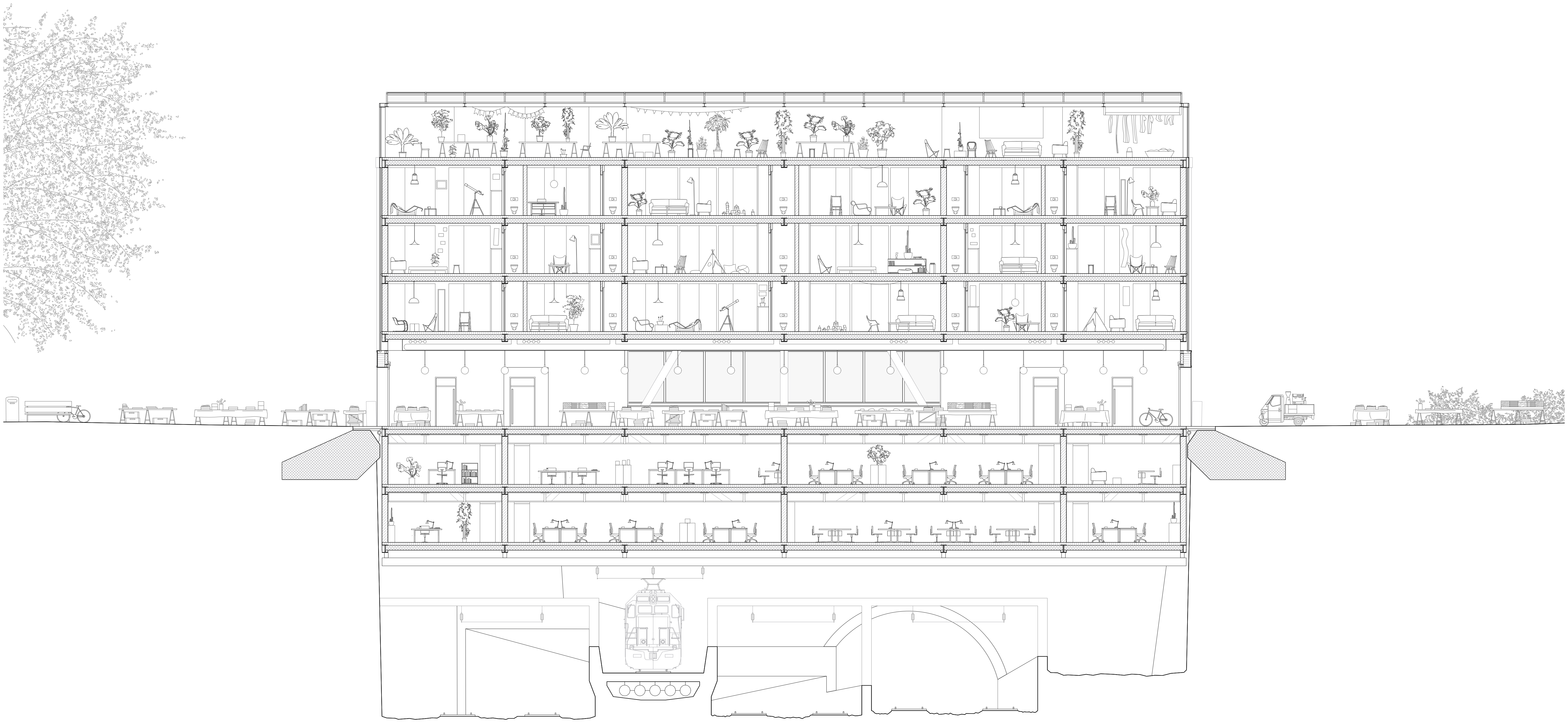
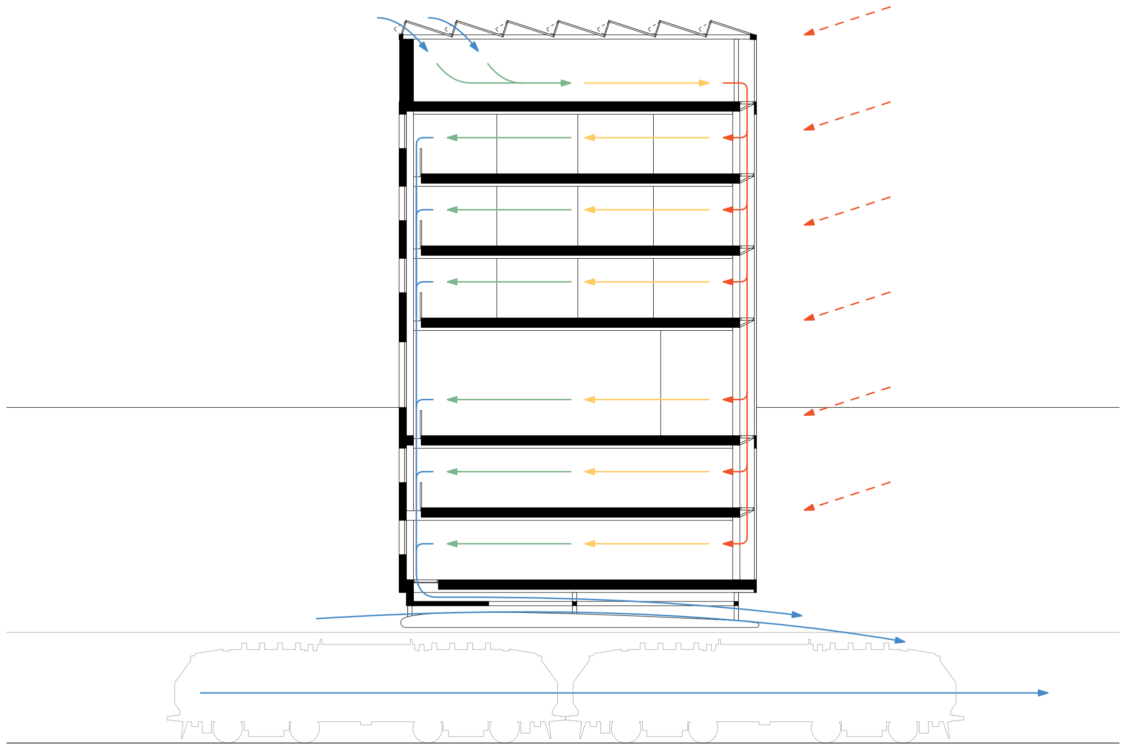
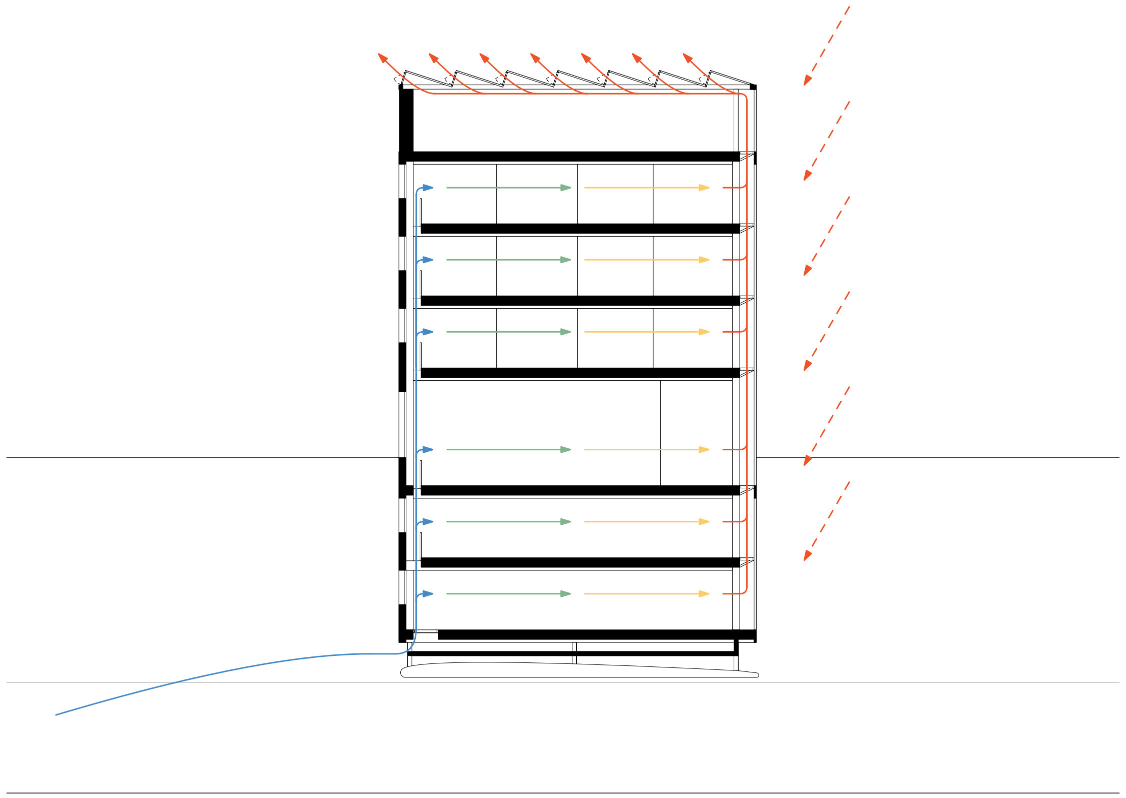


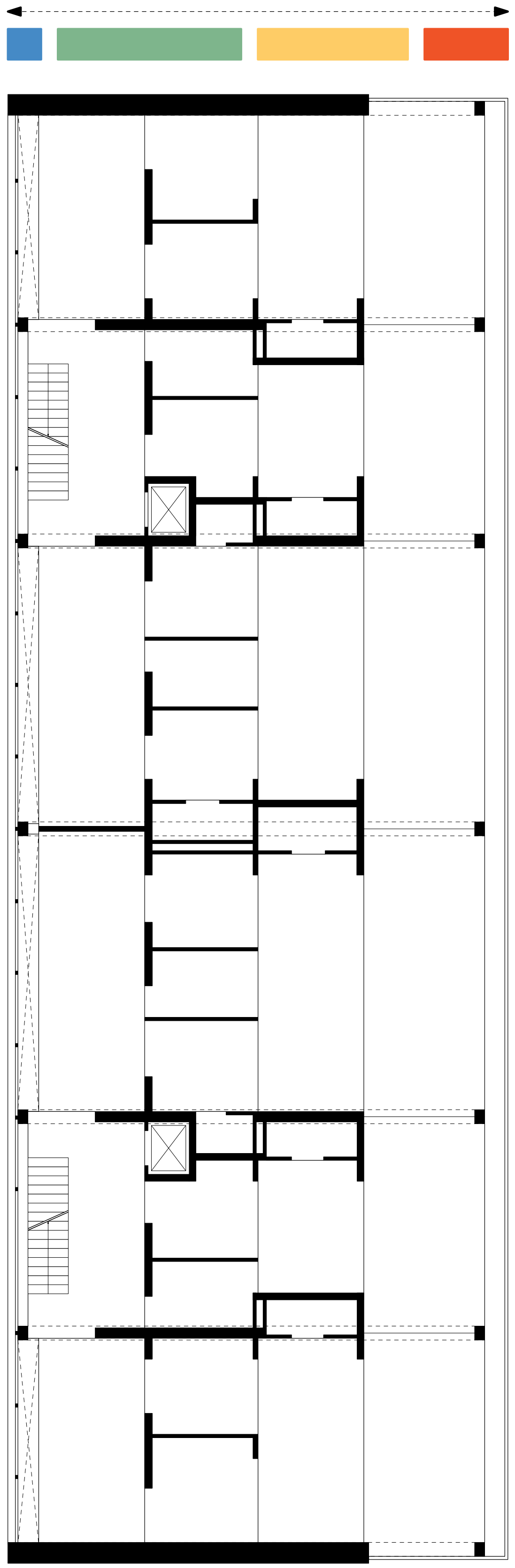
Section East-West



Winter air flow in the building



Sommer air flow in the building



Air flow in the apartments

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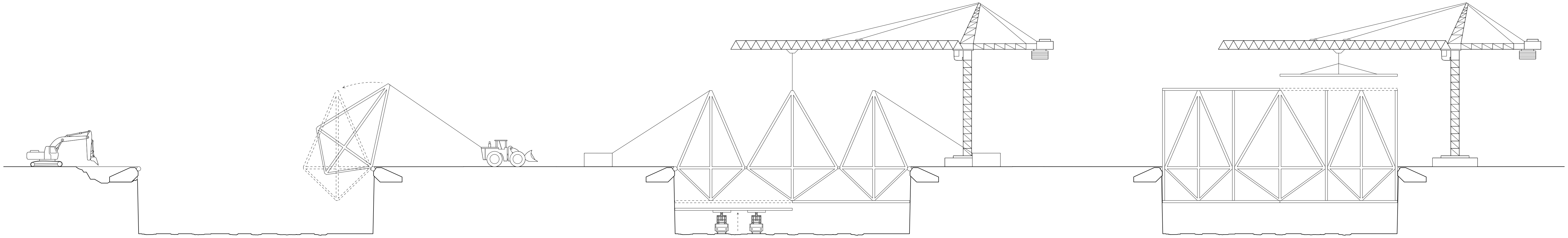

Construction of the Structure

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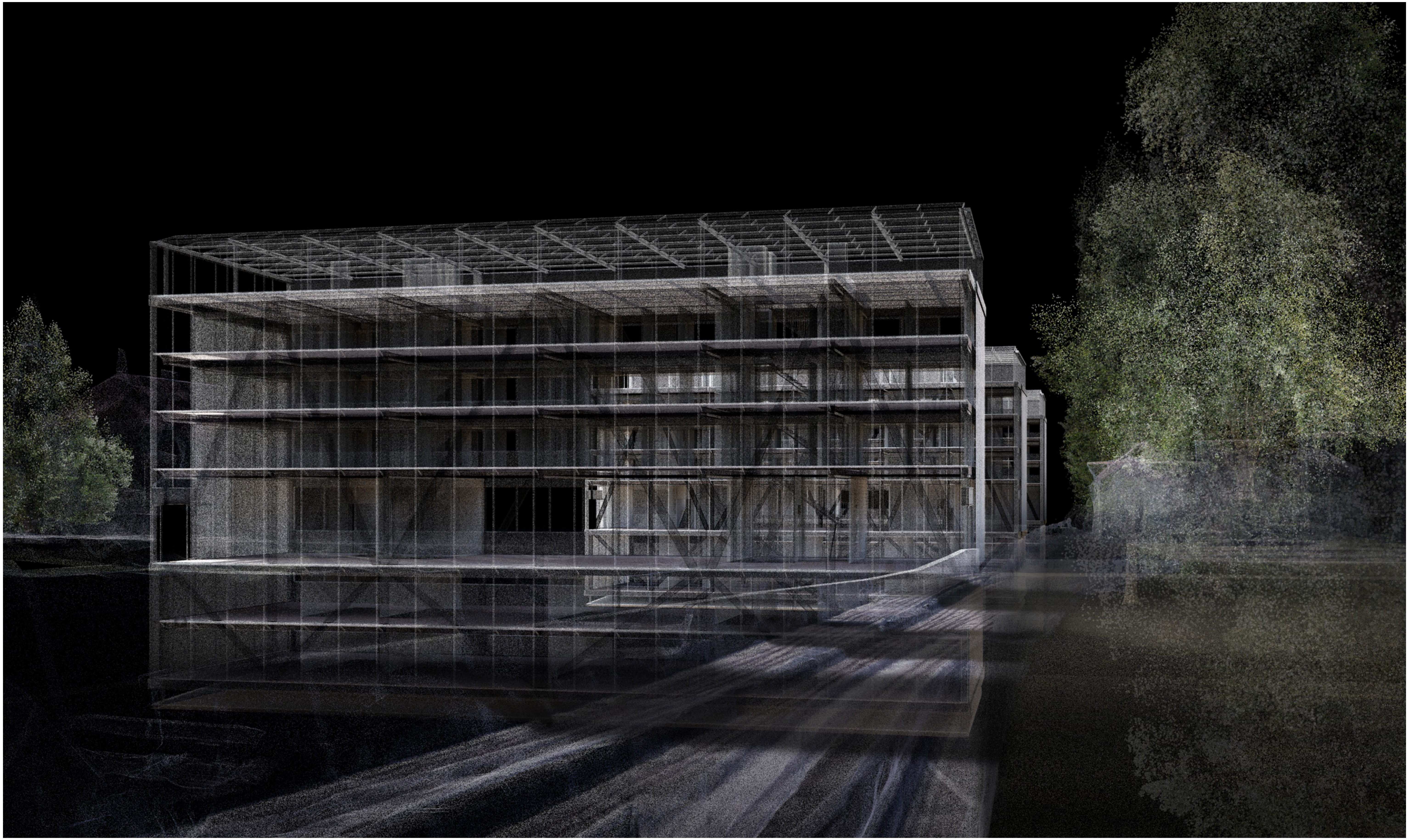

Point Cloud Exterior

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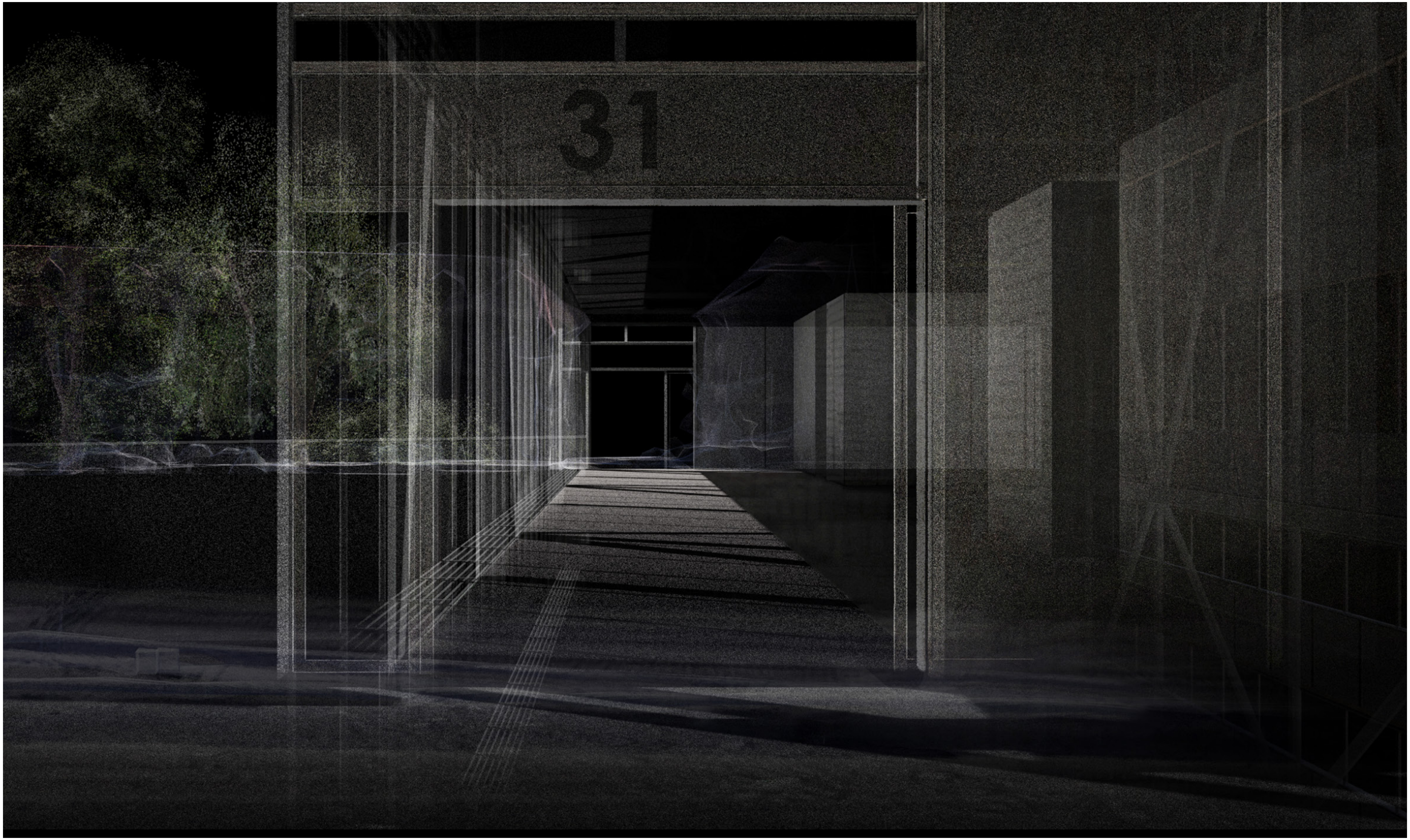
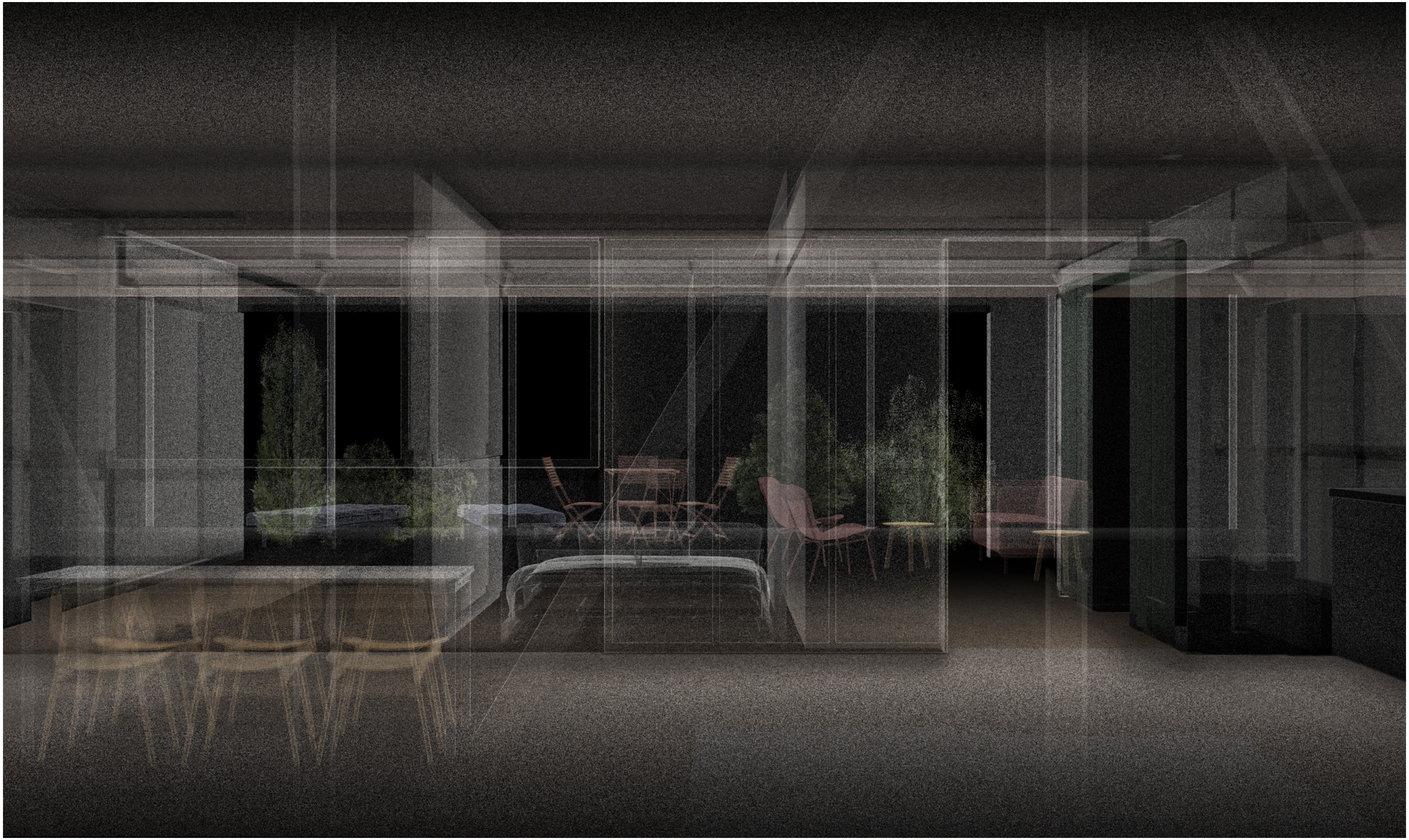


Point Cloud Bridge



Point Cloud Apartment

PROCESS

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A HISTORY OF THERMAL COMFORT/CONTROL

The history of architecture showcases a wide range of very well documented subjects such as typologies, ornaments, building types etc. However, talking about thermal comfort throughout the ages is a challenging task as it refers to subjective feelings that might have evolved through time.

Nevertheless, It might make more sense to talk about thermal control instead as we might be able to work on the principles used in many different buildings and regions at many different times and begin to find common ground to cross compare them. There are two common sense principles to identify that can help control the temperature inside of a building. On the one hand a space can be heated, it has been done historically with fire and more recently technical heating systems such as radiator have been implemented in constructions. On the other hand, a space can be cooled down, unlike heating, cooling down cannot be done with a fire as one needs to retract heat from the air (Taylor 1983). Starting there, I'd like to discuss the cooling principles that have been elaborated through time and empirical experiments around the world and see if one can relate them to the Bürgerhäuser in the Canton of Zurich.

To begin our journey I'd like to talk about the so-called Malqaf. This windcatcher is an Egyptian vernacular archetypal device allowing a building to trap the wind and let the air circulate in order to provide ventilation. The first mention of the Malqaf dates back to 1300B.C (Attia, De Herd, 2009). This principle evolved and traveled in the mediterranean region and the persian gulf (Roaf, 2005). Indeed, examples can be found in the persian empire such as the Dowlatabad Garden and its nearly 35 meter tall windcatcher or the Borujerdi House and its three 40 meter tall windcatcher both built between the 16th and 17th century. Interesting to notice in those more recent persian examples is that the windcatcher is coupled with other passive cooling principles such as water bassin or plants that cool the incoming air down, large walls preventing heat radiation and more importantly a chimney allowing the air to escape and thus using the stack effect (Omidreza, Lim Chin, Sopian, Sulaiman, 2012).

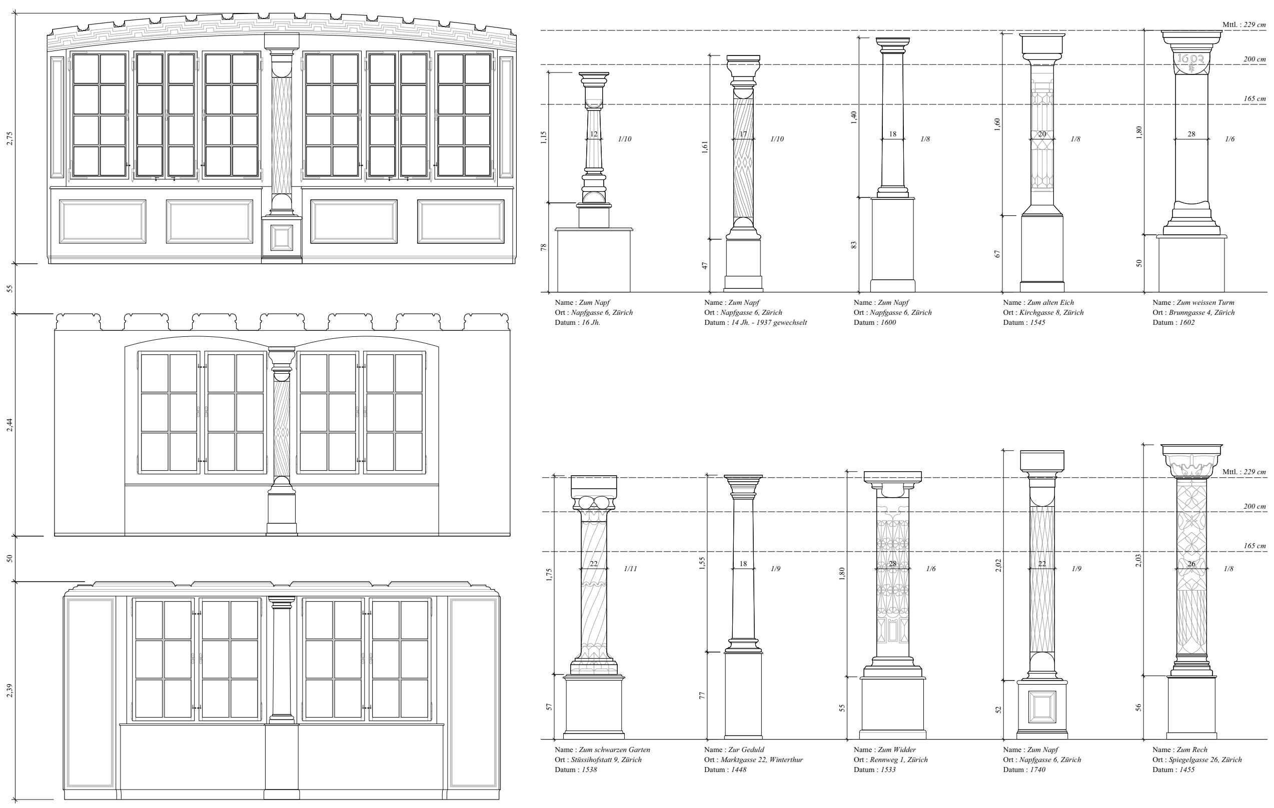
This empirical way of dealing with the thermal control of the building's interior can also be derived in European architecture. As mentioned, the thick walls keep the heat outside, stack effect is used to let air circulate in the building and plants are used to cool down the outside air. Those are characteristics of Bürgerhäuser and more widely of middle age european bourgeois architecture. Even though the subject has not been extensively studied by historians, the observations one can make show a connection to the Middle East approach on dealing with ventilation and thermal control during summer.

With the rise of modern architecture in the beginning of the 20th century, architects have been concerned with the quality of air and the thermal control inside of buildings (Colomina, 2019). A great example of passive design reacting to the environment by taking advantage of the climatic, sun and wind conditions as well as the plants and water's natural cooling effect is the History faculty of the Cambridge university built in 1968 by James Stirling and mentioned by Reyner Banham in his architectural review about the building (Banham, 1968).

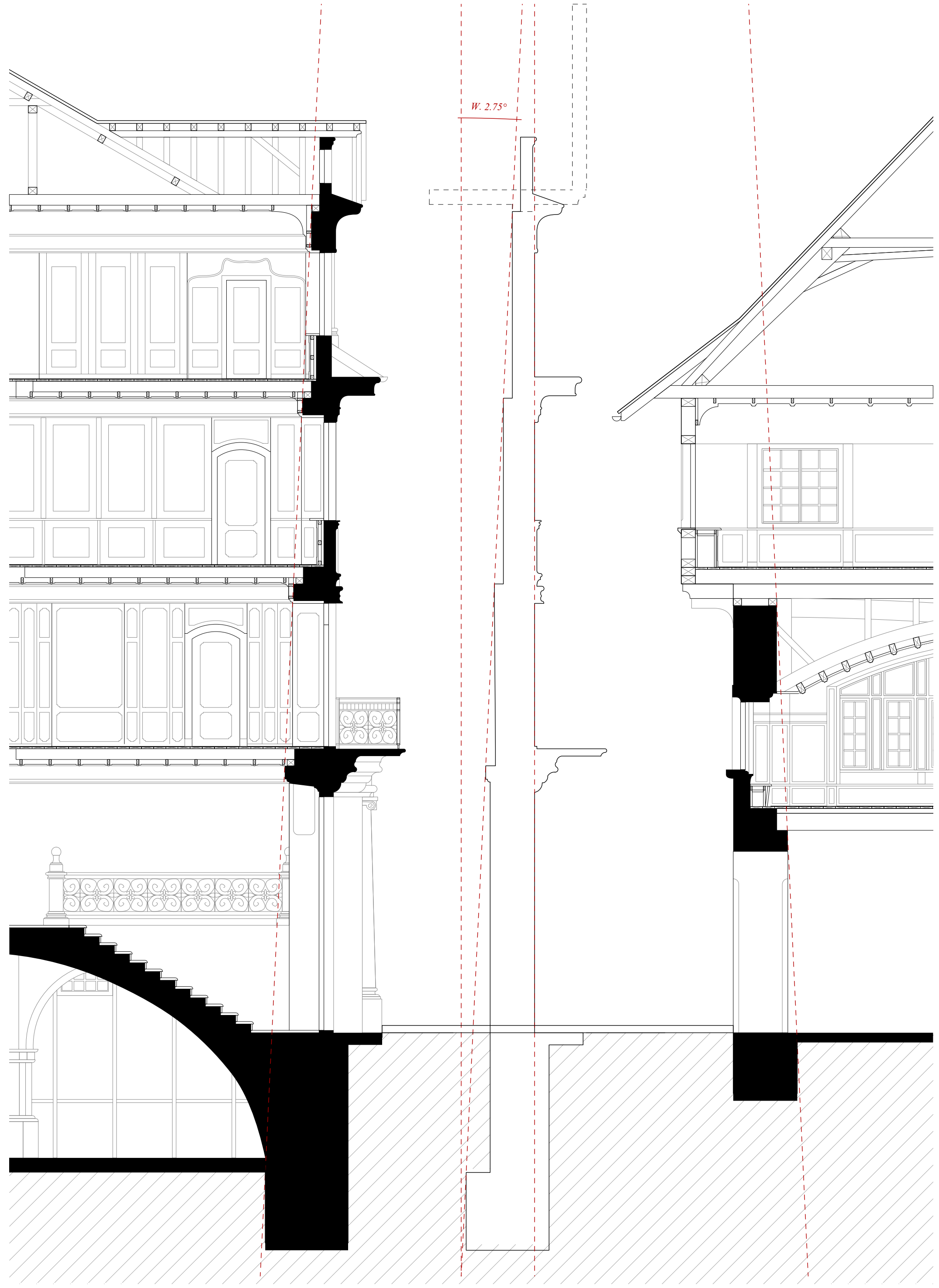
It uses passive cooling and ventilation but unlike before enhances it with scientific based knowledge and not empirical experimentations.

Nevertheless this scientific knowledge also allowed the designers to encapsulate interior spaces in artificially controlled environments leading to a distancing between inside and outside climatic conditions (Me, 2002). The history of thermal control and passive ventilation has made a rapid shift towards active ventilation and thermal separation using energy and insulation as its main tools.

1. ATTIA S. DE HERD A. (2009, June). Designing the Malqaf for Summer Cool ing in Low-Rise Housing, an Experimental Study. 26th Conference on Passive and Low Energy Architecture, Quebec City, Canada.
2. BANHAM, R. (1986, Novembre). Reyner Banham reviews James Stirling's Cambridge History Faculty. Architectural Review.
3. COLOMINA, B. (2019, April). X-ray Architecture. Lars Müller Publishers.
4. Me, A. (2002, February). Cool Comfort : America's Romance with Air-Condi tioning (1st Edition). Smithsonian.
5. OMIDREZA S. LIM CHIN H. SOPIAN K. SULAIMAN M.Y. (2012, April). Review of windcatcher technologies. Renewable and Sustainable Energy Reviews. Volume 16, Issue 3.
6. ROAF, S. (2005, April). Air-conditioning avoidance: lessons from the wind catchers of Iran. International Conference "Passive and Low Energy Cooling for the Built Environment", May 2005, Santorini, Greece.
7. TAYLOR, J. S. (1983, Octobre). Commonsense Architecture : A Cross-Cultural Survey of Practical Design Principles (1st Printing). W.W. Norton.

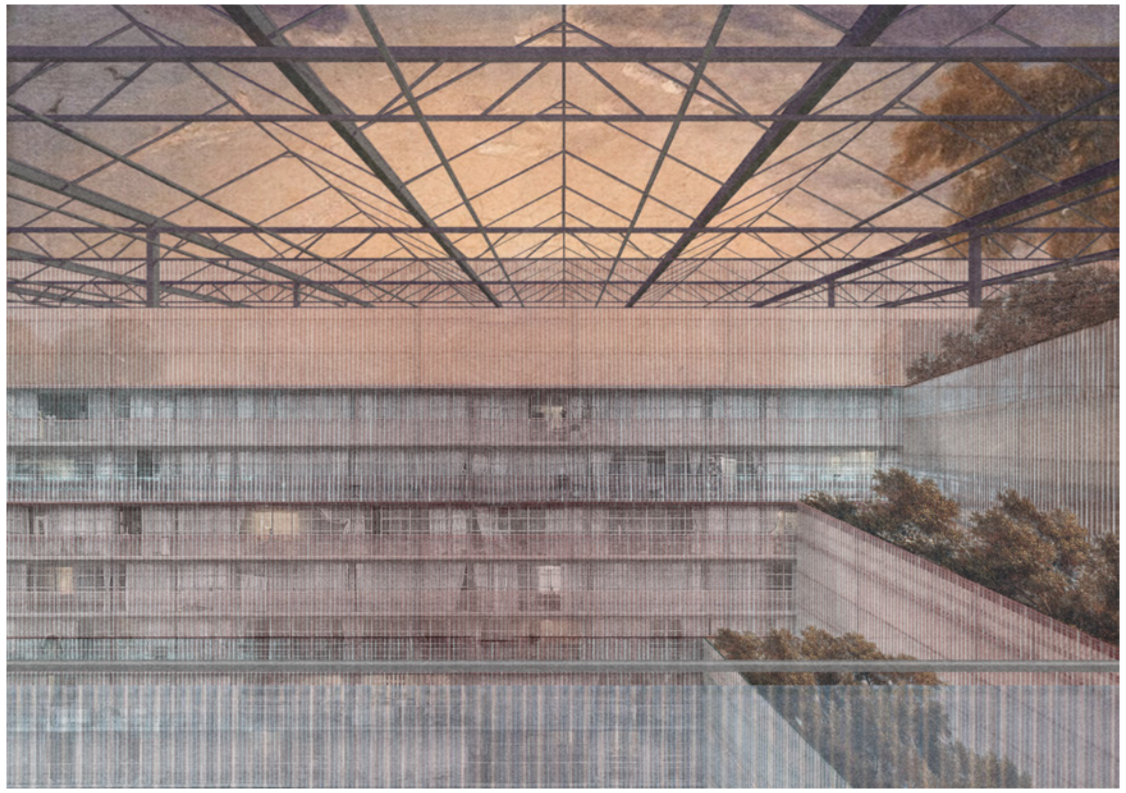


Standard?, Drawing study of wall columns types in the Bürgerhäuser

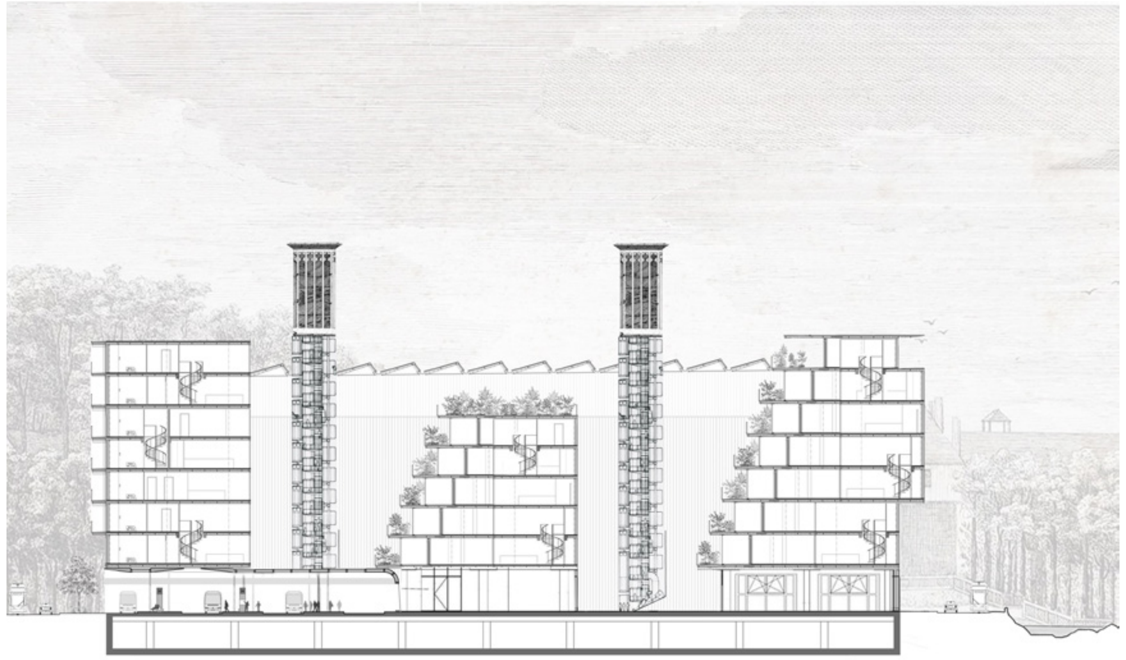


Structural angle, Drawing study of the static in the Bürgerhäuser

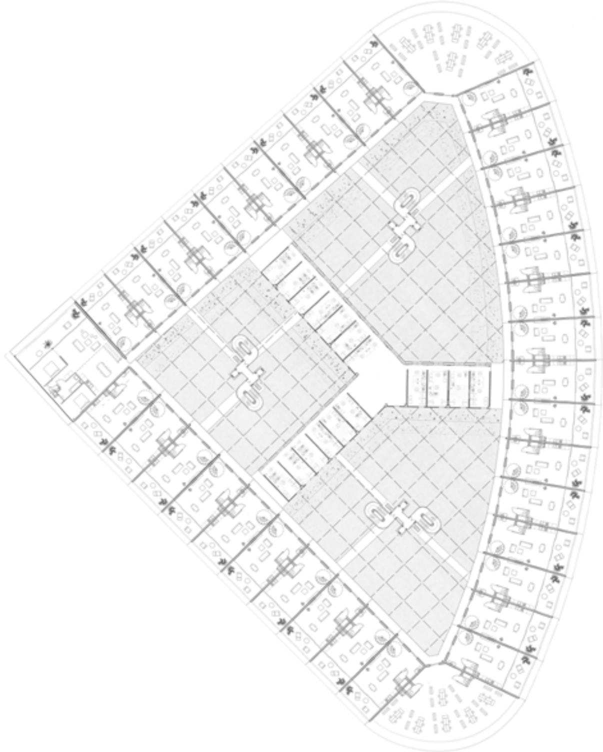
Collage Layers Research



Collage Shared Space Research



Collage Section Research



Collage Plan Research