



COMMON HEAT. COMMON RESILIENCE.

Graduation Report

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AR4DC100

Architectural Design Crossovers Graduation Studio (2025/26 Q2)

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Reading guide

This document is the Graduation Report of an architectural graduation project. In this report, the research and design process is documented. The project is situated in the neighbourhood of Pradolongo, Madrid. It intends to improve on the neighbourhood's heat resilience by exploring possibilities for thermal commoning.

Part 1.

Introduction

Problem statement

We design a world that suits our needs. But our needs are never satisfied, so our designed world becomes more and more complex. It has gotten to a point that the world around us has become like a 'black box', we do not understand it anymore; 'we live our lives within these invisible systems, blissfully unaware of the artificial life, the intensely developed infrastructures, that support them.' (Mau et al., 2004).

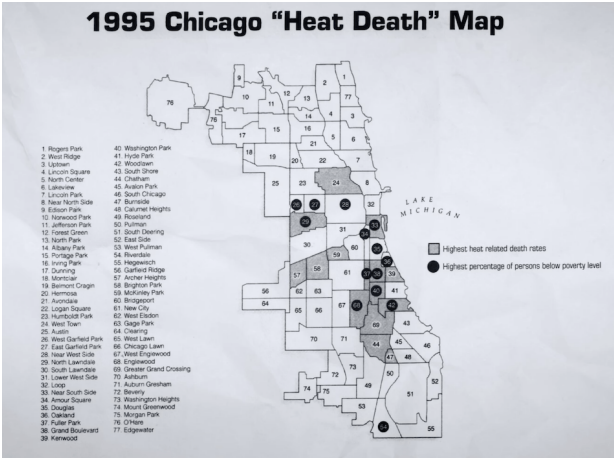
With that, we also no longer take responsibility for our modified world. We ignore the harmful effects of these systems on our world and the people around us. We cause global warming, and with that 'The human might be the only species to have systematically designed its own extinction, and seems to be getting close to accomplishing the goal.' (Colomina and Wigley, 2017).

It was in Chicago in 1995 that a massive heat stroke plagued the city. Air conditioning was used as a lifesaver, but it became a heavy load on the power grid. It was an important cause of the power grid eventually failing, along with other essential infrastructure. More than 700 people lost their lives during this heat wave. Most of the victims were elderly without access to air-conditioned spaces, which could sound obvious. Low-income neighbourhoods recorded more heat wave victims generally (Klinenberg, 2002).

But something else also played a role; Klinenberg noted that not all low-income neighbourhoods had high mortality rates. Englewood recorded 33 deaths per 100,000 residents, while Auburn Gresham recorded only 3 per 100,000. Neighbourhoods like the last one had a strong 'social infrastructure', which he explains as 'the physical



Food getting spoiled in a non-functional freezer. From CBS Chicago (1995)



Chicago Heat Death Map. Reprinted from "Slow-Motion Disaster and Extreme Weather: Five Questions for Judith Helfand" (Edge Effects, 2021)



"Bombed Out": an empty lot in the residential area in North Lawndale. From Palaces for the People: How Social Infrastructure Can Help Fight Inequality, Polarization, and the Decline of Civic Life, by E. Klinenberg, 2018, Crown



Commercial activity supports a booming street life on Twenty-sixth Street in Little Village. From Palaces for the People: How Social Infrastructure Can Help Fight Inequality, Polarization, and the Decline of Civic Life, by E. Klinenberg, 2018, Crown

places and organizations that shape the way people interact' (Klinenberg, 2018).

This indicates that heat resilience means more than the ability to stay cool in extremely high temperature weather conditions; a social dimension comes with this, which needs more emphasis.

Here comes the job for the architect.

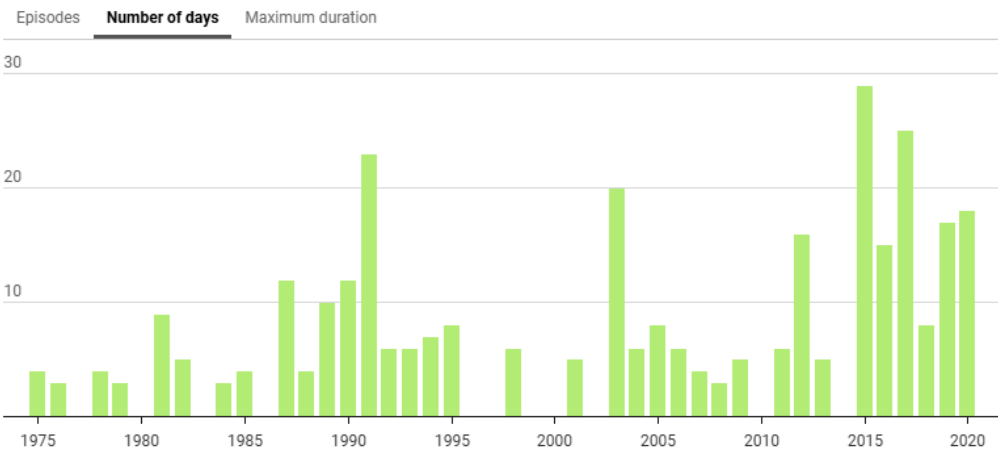
Revelance

Thanks to climate change, heat waves occur more often globally, last longer, and are simply hotter. This extreme weather phenomenon is especially prominent in (bigger) cities, because of the Urban Heat Island effect (Yang et al., 2016). Heat waves are not just uncomfortable to experience; they are the most deadly kind of natural disaster (Klinenberg, 2002).

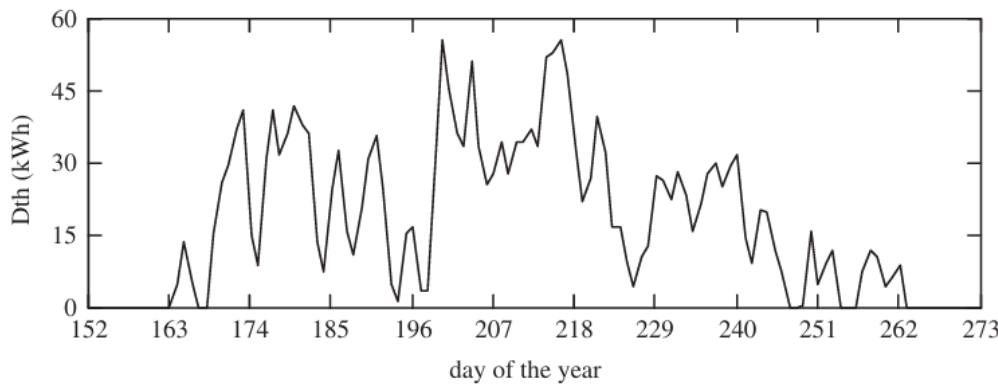
In order to deal with extreme heat, air conditioning devices are widely used. Although being very effective at cooling indoor spaces mechanically, their energy demand is very high. They also emit heat drawn from the cooled room to the outside of the building, warming the environment further. When used extensively, they cause a high energy demand and therefore spike up power bills (Aranda, 2021).

The design studio of this graduation project is focusing on the city of Madrid, a city of more than 7 million people in the middle of the Iberian Peninsula. With a mediterranean climate causing hot summers, heat waves cause around 1,000 deadly victims yearly (The Wave, n.d.). Madrid is no stranger to air conditioning, causing energy prices to go up during hot summers. This results in the fact that for 13,1% of Madrid's households, the energy bill is more than 10% of their yearly income (Sánchez et al., 2020).

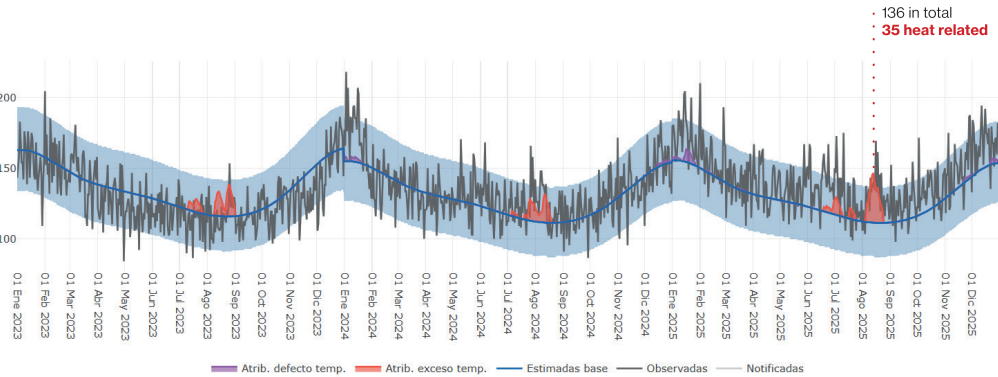
Heatwaves in Spain



Heatwaves in Spain. From “Spain prepares for record-breaking high temperatures as heatwave intensifies” (El Pais, 2021)



Seasonal thermal demand per home in Madrid in 2008. From Izquierdo et al. (2011)



Reported, observed, expected, and temperature-attributable mortality. (MoMo, n.d.)

Objective and motivation

Looking at the case of Chicago and also Madrid, it can be concluded that air conditioning, or mechanical cooling in general, is a half-way solution. It makes a city more heat resilient, but at what cost?

The devices increase the urban heat, drive up energy consumption, and therefore CO2 emissions because of increased fossil fuel usage (Aranda, 2021). They make energy prices go up, causing energy poverty, and are unreliable ‘black boxes’ because of increased risks of power outages.

But that is only at the practical side of things. In order for air conditioning to function, an enclosed space is needed, and someone has to pay the energy bill for cooling the space. Like this, the cooled space is privatised, and accessibility is limited. How does this help social infrastructure, mentioned earlier, which is so important for heat resilience (Klinenberg, 2018)?

Within the graduation studio, the topic of ‘commons’ is being discussed. Traditionally, common-pool resources containing “all the creations of nature and society that we inherit jointly and freely, and hold in trust for future generations” (Hodkinson, 2010). However, modern interpretations also include social commons, like open public space, or caring for the elderly (Collective, 2022).

Shelter from heat can also be seen as a common resource, in both the traditional and modern sense. One could call it ‘thermal commons’.

The project wants to rethink heat resilience. It wants to shed light on the importance of thermal commoning, and function as an example for future projects.

Besides that, it has the ambition to be as independent on mechanical temperature regulation as possible. This will be done by incorporating design techniques for passive cooling.

In order to increase the effectiveness of the project, it will be situated in an area of Madrid known to have high heat vulnerability.

The project intends to answer the following question:

How can an architectural intervention promote thermal commoning in a neighbourhood experiencing heat vulnerability?

Pradolongo



Risk in low income areas as a function of the number of overlapped vulnerability indicators. From Sanchez-Guevera et al. (2019).

Scope

Sanchez-Guevera et al (2019) did a study on Madrid's vulnerability towards energy poverty (see figure). It showed the neighbourhood Pradolongo, part of the district Usera, is one of the most vulnerable. This is because it is a low income area, with multiple other negative factors.

The urban fabric is very dense and small-scale. The project should not 'over-rule' this urban landscape, so it needs to adapt itself. Also looking through the lense of commons, it is important to add to a neighbourhood instead of taking away.

Pradolongo is a residential neighbourhood with small apartments on the upper floors and amenities or parking garages at the bottom. With the neighbourhood being very dense, streets are typically only between 7.5 and 9 meters wide. Because of this, qualitative outdoor space is very limited.

The project is talking about thermal commoning as a new answer to solving heat vulnerability. Although this implies a focus on the public / shared / common space, heat resilience should also extend to the private space. That is why the project wants to include the home, the public space, and the in-between spaces.

Part 2.

Approach

Methods

Desk research

week 1.1 - 1.10

The project started with an exploration of architectural theory and topics. Reading and explaining literature to other students helped with forming an architectural position around the topic of commons, and also of infrastructure being a 'black box'. These black boxes were translated into air conditioning devices, with their impact on society. The case study of the Chicago heat wave functioned as a striking example of what happens when infrastructure, and with that air conditioning, fails. In addition to this, the heat problems in Madrid were studied. Much scientific literature was written on energy poverty, also in Madrid. This research resulted in a proposal addressing the issue of energy poverty in Madrid, the 'doom scenario' of Chicago, and the importance of social infrastructure as a source of heat resilience.

Field research

week 2.1

An eight-day field trip to Madrid followed, during which extensive walks through Las Tablas, Pradolongo, and Recoletos were made. The goal was to spot urban and architectural characteristics that would allow for thermal comfort. These were photographed. The reason for visiting these three neighbourhoods specifically was that they had very different relations to heat vulnerability.

Processing field research

week 2.2 - 2.3

Afterwards, the findings were organized in schematic visual representations. This made the neighbourhoods comparable and led to conclusions. The building blocks

throughout Madrid, and also the closed facades, have a difficult relationship with thermal comfort. The inside of the block offers a cool environment, while the public domain stays outside of the block.

Concept design

week 2.4 - 2.9

Experimentations on the transformations of these blocks followed, mainly by sketching. By introducing porosity in both the blocks and the façade, thermal comfort would be encouraged. By mapping the many different amenities in the neighbourhood and their opening hours, their potential for being a 'gateway' to the inside of the block, the courtyard, was discovered. The conceptual design was a proposal for re-organizing the blocks with varying courtyards that were more open to the public, the amenities functioning as catalyzers.

Developing design

week 3.1 - 3.7

In the next design phase, more technical questions were given attention. The focus lay on maintaining this commonness and openness of the project, while making it resilient to heat physically. The two main elements playing a role were shadow and natural ventilation. For minimizing sun exposure, sun pattern analyses were conducted. For learning about natural ventilation principles, scientific papers on the behaviour of air in courtyards were used.

Presentation and evaluation

week 3.8 - 3.10

To present the final design, a combination of technical and architectural drawings is used, alongside impressions. The pre-

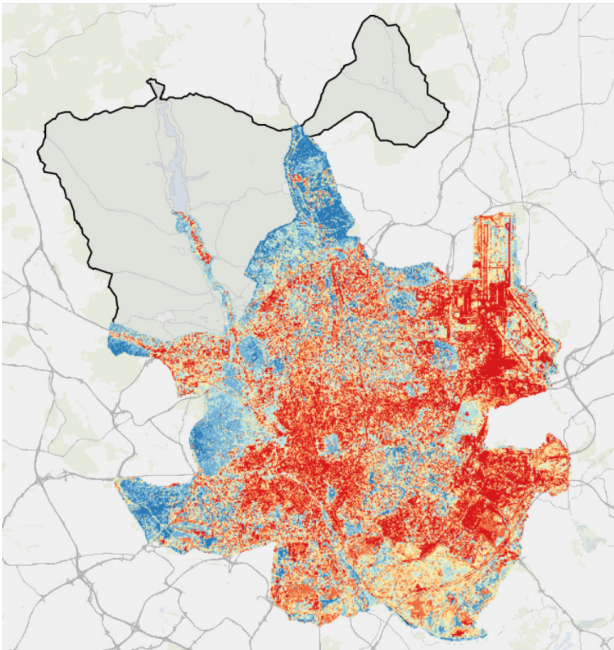
sentation will lay emphasis on the topic of thermal commoning, showing the porosity of the project in a social and technical sense.

Theoretical framework

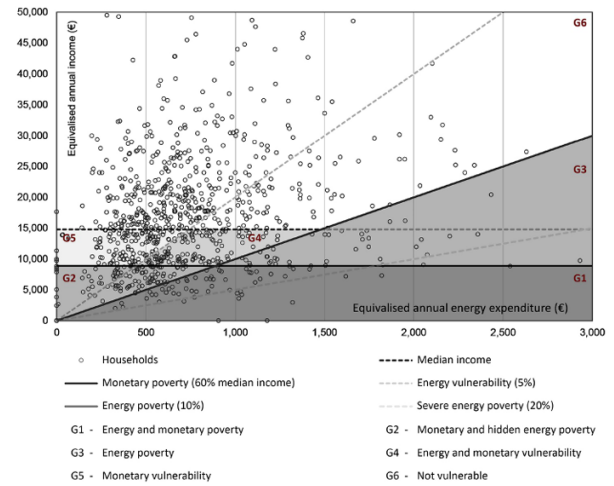
Heat vulnerability

Heat
In Madrid, summers get uncomfortably hot. Thanks to global warming and the Urban Heat Island effect (an increased temperature in cities due to construction and other humans activities (Yang et al., 2016)), the city gets hotter through time. A study showed that for every degree above 36.5 degrees Celsius, mortality rates increase by 28.4% in Madrid (Díaz et al., 2002).

Energy poverty
In order to cool their homes, households in Madrid heavily depend on air conditioning. However, the high amount of energy required can get expensive. When in high demand, energy is sold off at a higher price. So this means that in general, when more electricity is used on air conditioning in summer, energy prices increase (Aranda, 2021). This results in the phenomenon of energy poverty, meaning a household has to spend more than 10% of their yearly income on energy. With average incomes varying between 23,000 and 54,000 euros between neighbourhoods (Sanchez-Guevara et al., 2019), some are clearly more vulnerable than others. However, the amount of energy you need depends on building quality and the local Urban Heat Island effect.



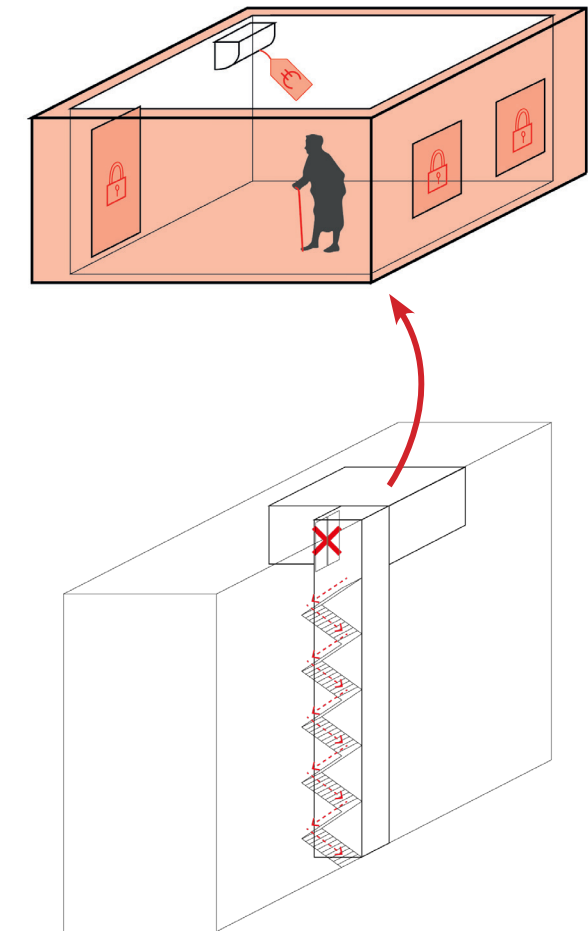
Thermal comfort in Madrid. From "Isla de Calor Urbano". (Portal de Teledetección del Ayuntamiento de Madrid, n.d.)



Households representation and subdivision according to their income and energy expenditure levels. From Sánchez et al. (2020)



Elderly people in Madrid trying to cope in the heat. From The Wave (La Ola) (n.d.).



Factors relating to mortality during the Chicago heat wave. Isolation playing a big part.

Age
Most heat wave-related deaths occur among elderly people (Bangalore, 2015). This shows that mainly because of their relatively fragile health, the elderly are especially vulnerable. This was also seen during the Chicago heat wave, with 73% of the victims being elderly (Klinenberg, 2002).

Isolation
Living in (self-imposed) isolation also increases a person's risk. This is especially the case among the elderly, as seen in Chicago. In neighbourhoods with high crime rates, the elderly were more afraid to leave their home and have face-to-face interaction. This is essential for receiving support. As a result, these neighbourhoods saw far more victims than others (Klinenberg, 2018).

Unfortunately, hot weather is associated with an increase in interpersonal violence (Acquadro Maran et al., 2024). In Chicago, an upsurge in violence happened before the heatwave.

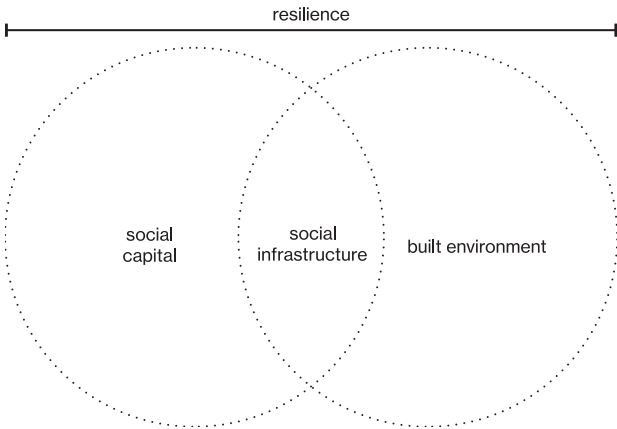
Thermal commoning

Social infrastructure

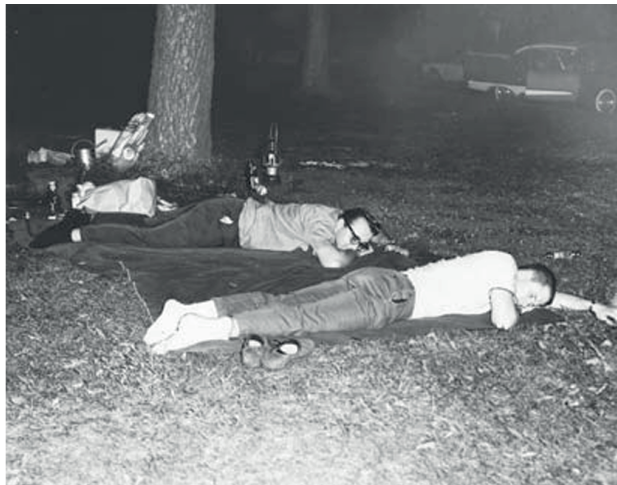
Klinenberg found the key factor leading to either high or low mortality rates in Chicago: the social infrastructure. He defines it as: 'the sidewalks, stores, public facilities, and community organizations that bring people into contact with friends and neighbors'. This made a difference, especially for the elderly, being able to visit nearby amenities.



A family relaxes in the yard on a hot day. From *Palaces for the People: How Social Infrastructure Can Help Fight Inequality, Polarization, and the Decline of Civic Life*, by E. Klinenberg, 2018, Crown



Klinenberg's definition of social infrastructure.



Sleeping outdoors during the heat wave, 1964. From *Palaces for the People: How Social Infrastructure Can Help Fight Inequality, Polarization, and the Decline of Civic Life*, by E. Klinenberg, 2018, Crown



When temperatures soar in Madrid, Spain, the *Círculo de Bellas Artes* cultural centre is turned into a climate shelter where people can rest in hammocks to escape the heat. "From Climate shelters aim to save lives during urban heatwaves" (Dialogue Earth, 2025).



CoolToRise project in Barcelona (participatory project). From "Climate adaptation through community engagement in Barcelona" (Cooltorise, 2024).

Climate shelters

In many Spanish cities, climate shelter networks are set up every summer to make the heat more manageable for residents (Maldita.es, 2024). These climate shelters are housed in different kinds of buildings throughout the city: libraries, theaters, sports centres, et cetera. These spaces are 'improvised' spaces to rest, often being air-conditioned.

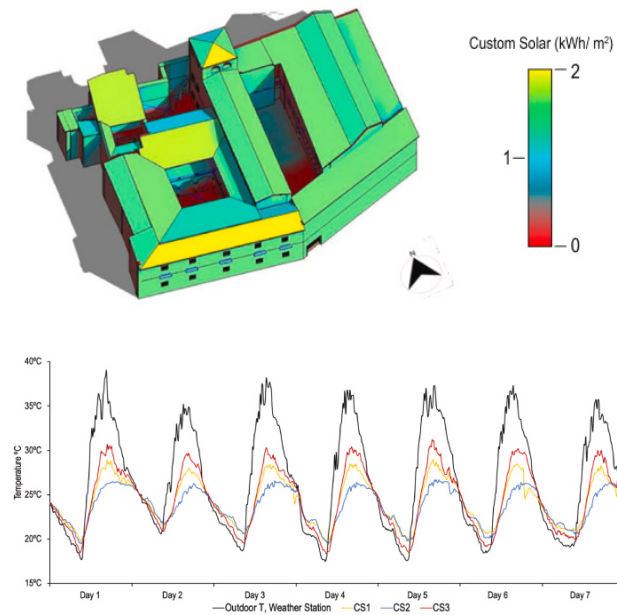
Bottom-up approaches are also being implemented, like the participatory project of Cooltorise in Barcelona. This involves a community in realizing its own 'climate shelter' (Simeonov, 2024).

The unofficial climate shelters

In the summer of 2021, a news article was written about an interesting heat wave observation. Shopping malls in low-income neighbourhoods were more busy than usual, while in high-income neighbourhoods these remained empty. The first were filled with ‘climate refugees’ wanting to cool down. The latter were traded for a nice swimming pool at home or a summer vacation (Peinado, 2021). This example shows a strong economic imbalance. The busy malls did not experience a significant sales increase, proving people were not there to spend, but were ‘forced’ to be there.



Three people take refuge in a mall in the San Blas neighborhood in the east of Madrid. From “The climate refugees in Madrid’s shopping malls: ‘They stay there all day because it’s cool!’” (El País, 2021).



Measured solar heat and temperatures in three different patios. From Diz-Mellado et al. (2023).

The patio

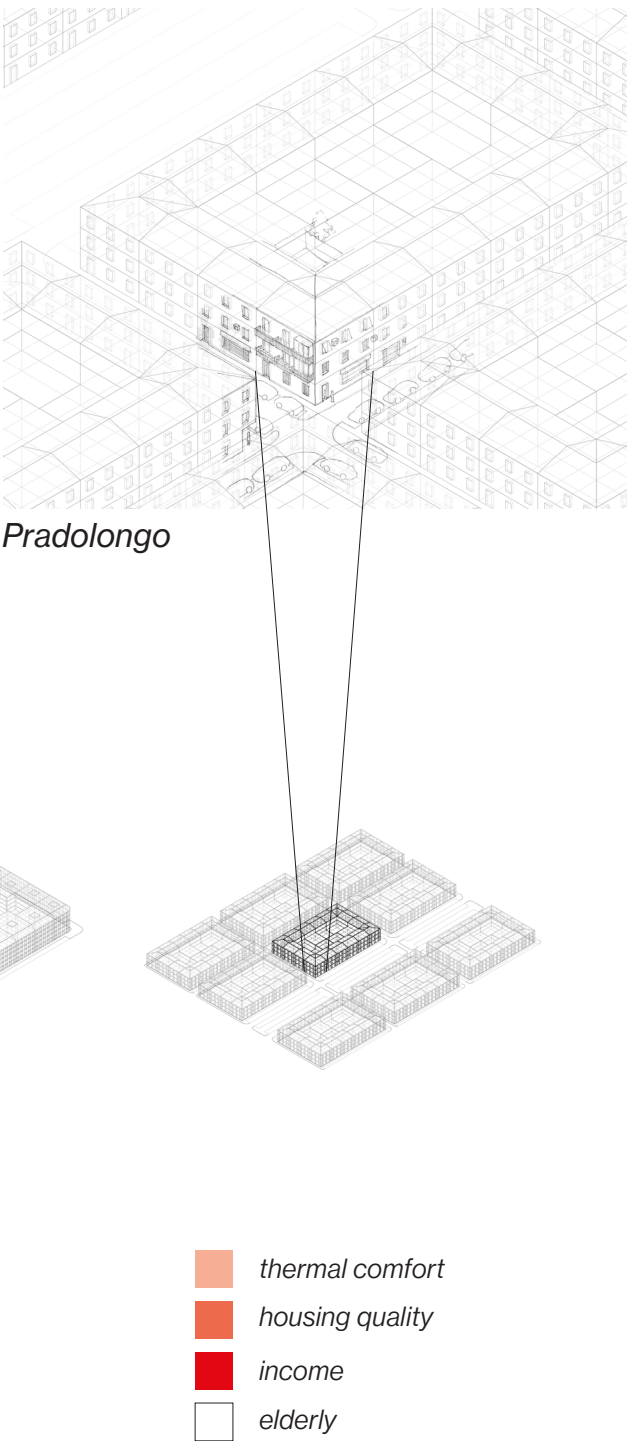
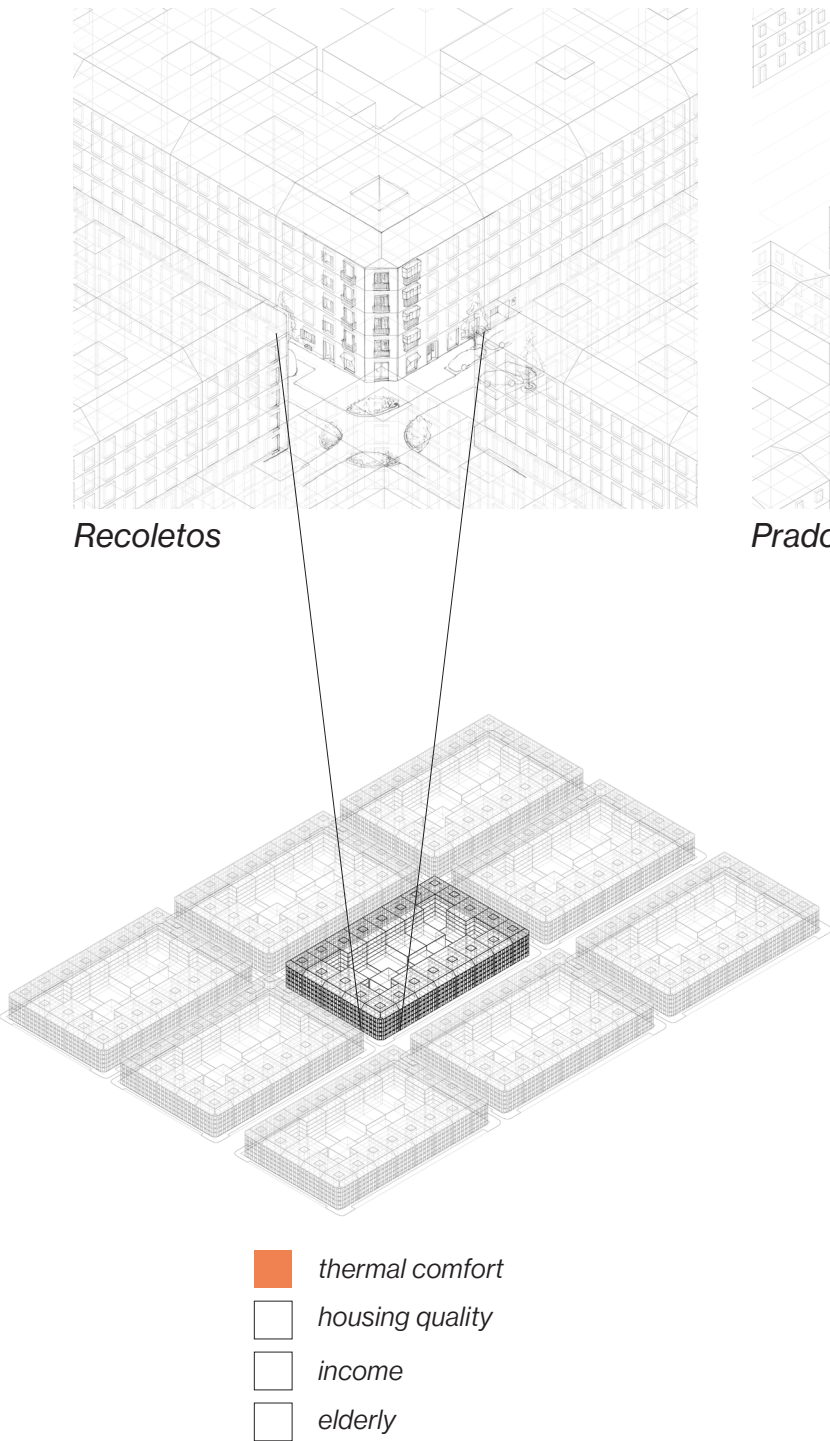
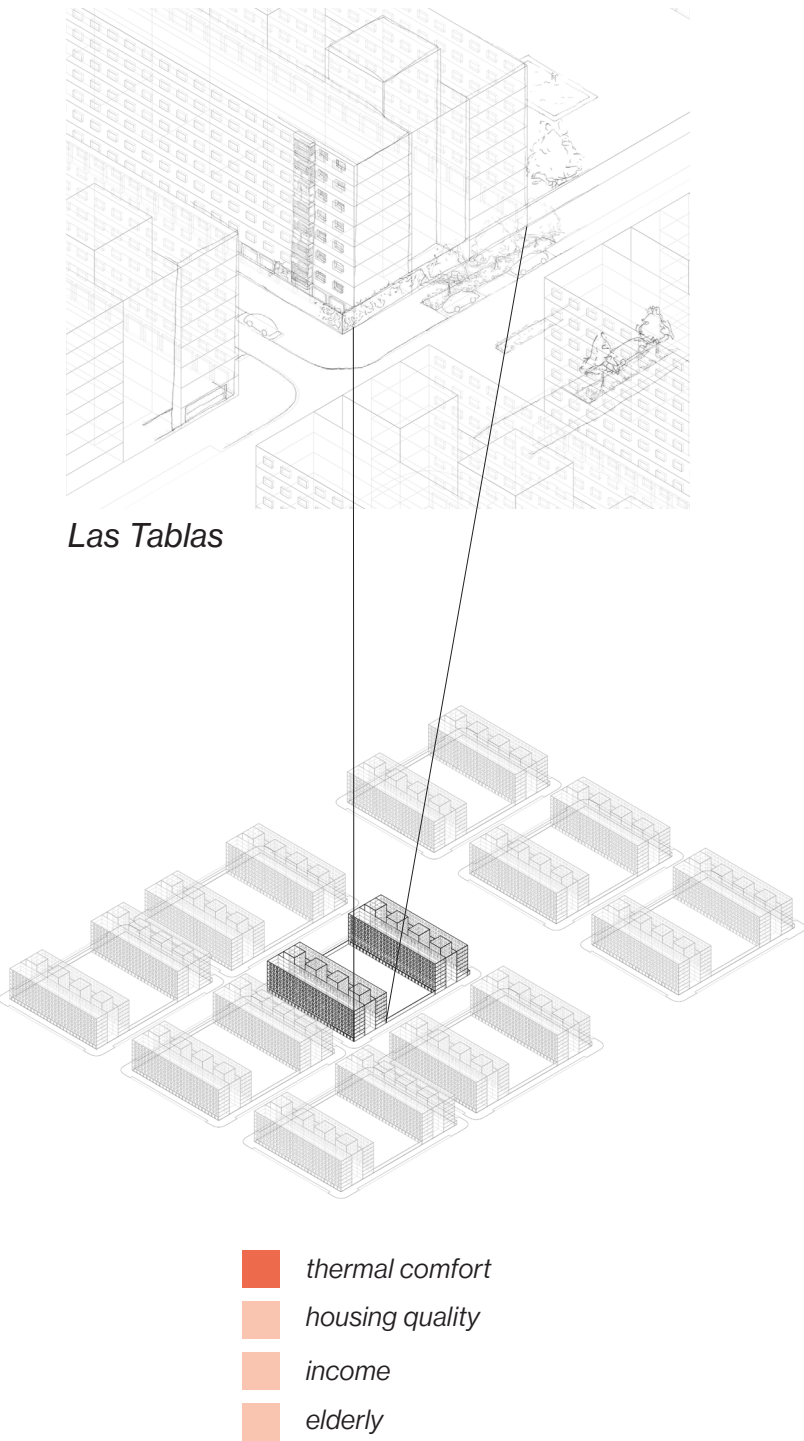
A patio (Spanish for ‘courtyard’) is ‘an area outside a house with a solid floor but no roof, used in good weather for relaxing, eating, etc.’ (Cambridge Dictionary, 2026). It is an architectural element traditionally used in Spain. It is a vernacular architecture designed to cool homes passively (Diz-Mellado et al., 2023).

Traditionally, it is also a place to socialize with family and neighbours (Reynolds, 2002). Therefore, they hold the potential for thermal commoning.

Part 3. Results

Visiting Madrid

During the site visit, the neighbourhoods Las Tablas, Recoletos, and Pradolongo were investigated. These neighbourhoods have different relations to heat vulnerability factors. The observations have been summarized schematically afterwards.



Looking at Madrid

Pattern

In general, across all three neighbourhoods, a pattern could be found. The neighbourhoods consisted of closed building blocks. The building was a clear barrier between the street, the public space, and the homes, the private space. The inside of a block consists of a shared courtyard or many small private courtyards. Entrance is forbidden for non-residents.

The bars before the windows and the heavy-looking facade emphasize the message of not being welcome.



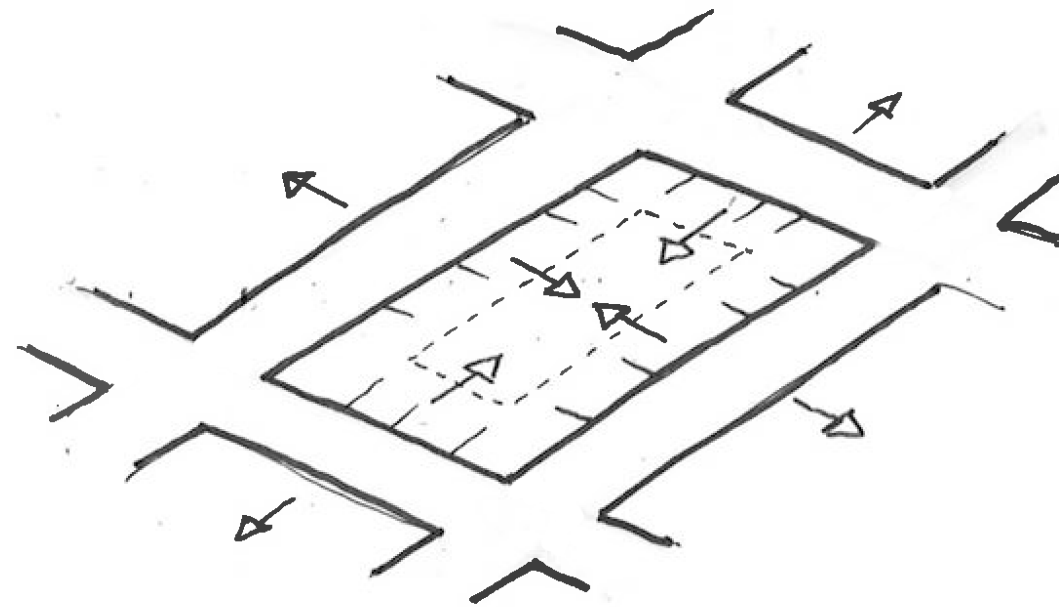
Las Tablas



Recoletos



Pradolongo



The closed building block

Looking at Madrid

Heat vulnerability

Elements were marked that were positive or negative for either the physical temperature or the thermal commoning.

For all neighbourhoods, the use of blinds and trees are elements having a positive effect. Large amounts of sun-exposed stone or asphalt had a negative effect. For Pradolongo specifically, there were many cars in the streets, making green additions to the street impossible. But these relatively narrow streets do offer shading.

Looking at the potential for thermal commoning, in general, (closed) balconies occur in all neighbourhoods, allowing for interaction. But the blinds that are used during the day counter this opportunity, along with the dominance of cars in the streets, forming a barrier from one side to the other side of the street. For Pradolongo, narrow sidewalks and parking garages reduce the street's attractiveness.

Temperature

Positive

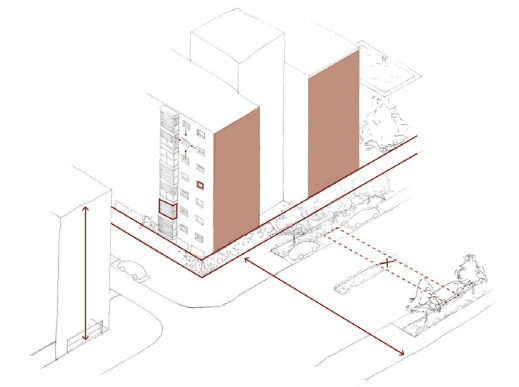
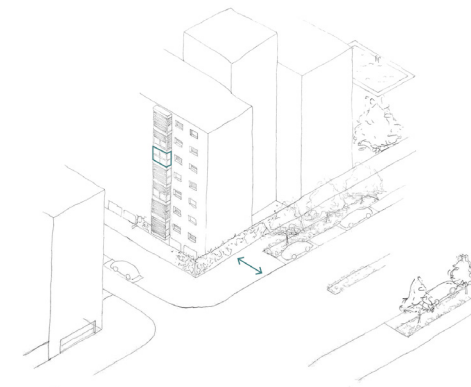
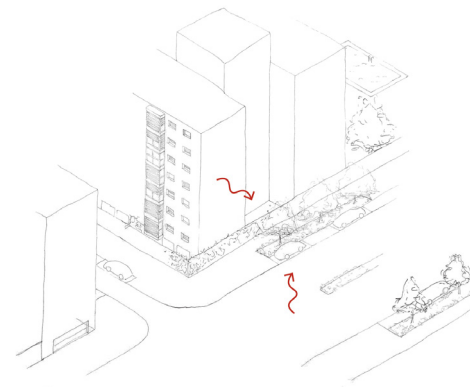
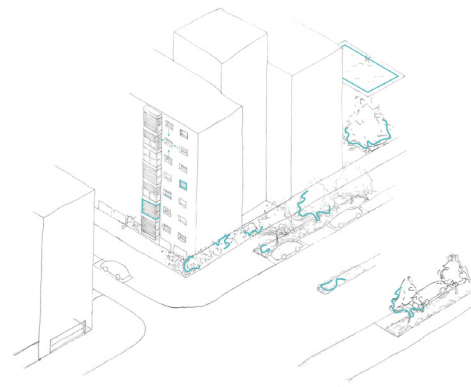
Negative

Thermal commoning

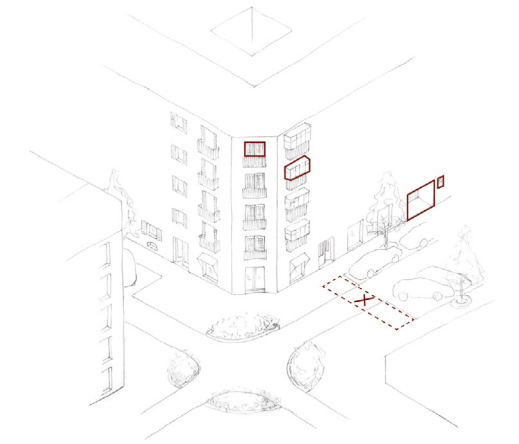
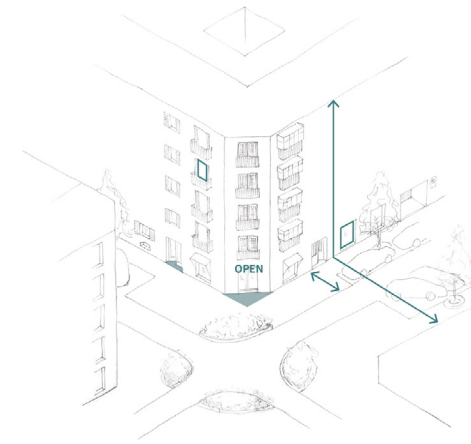
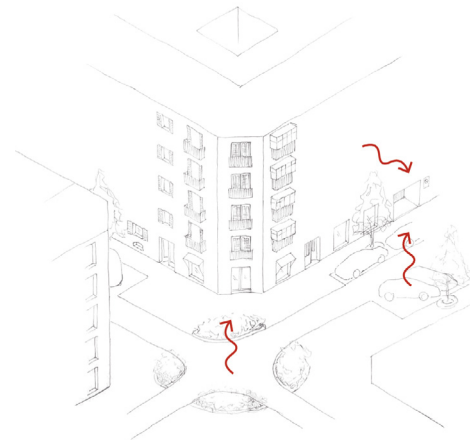
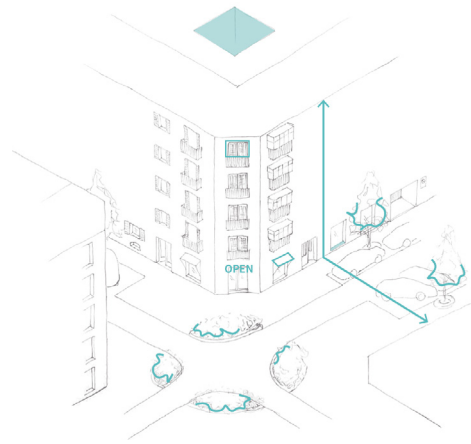
Positive

Negative

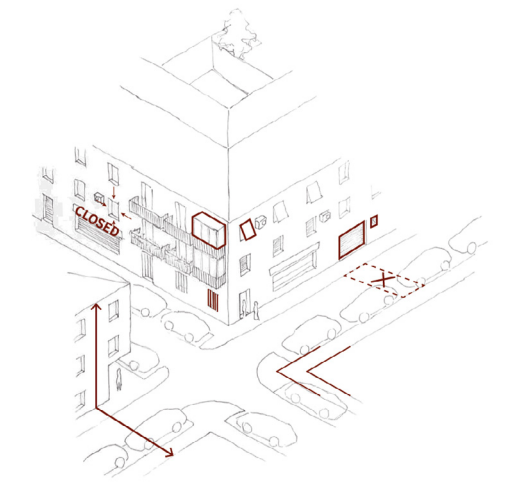
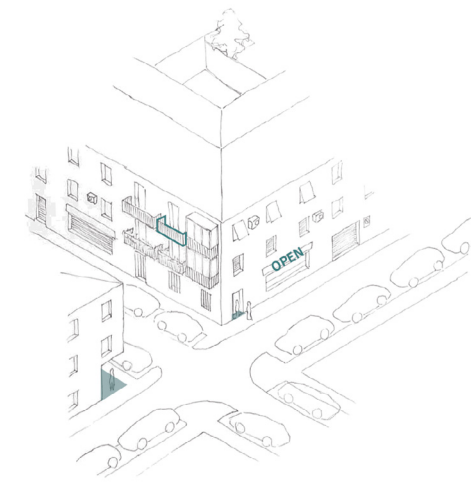
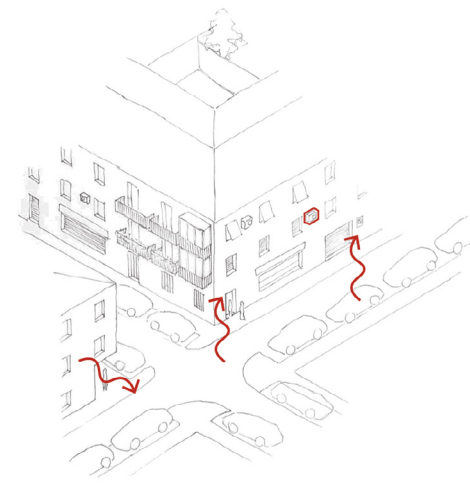
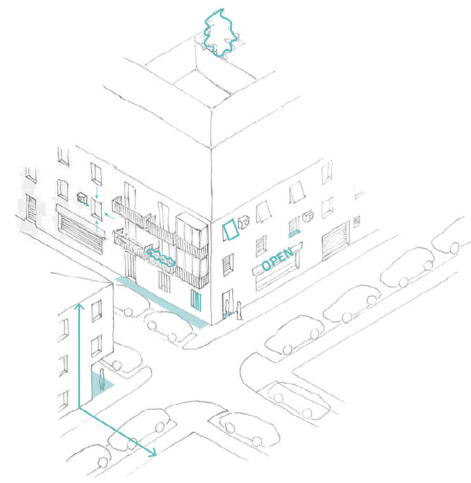
Las Tablas



Recoletos



Pradolongo

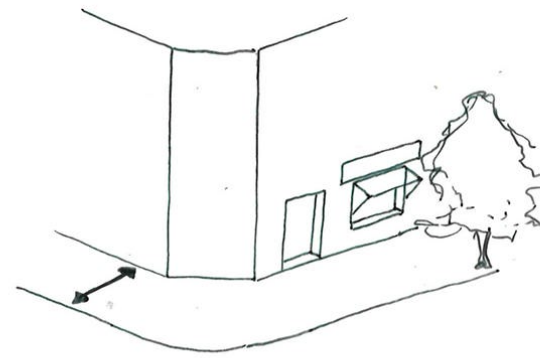


Looking at Madrid

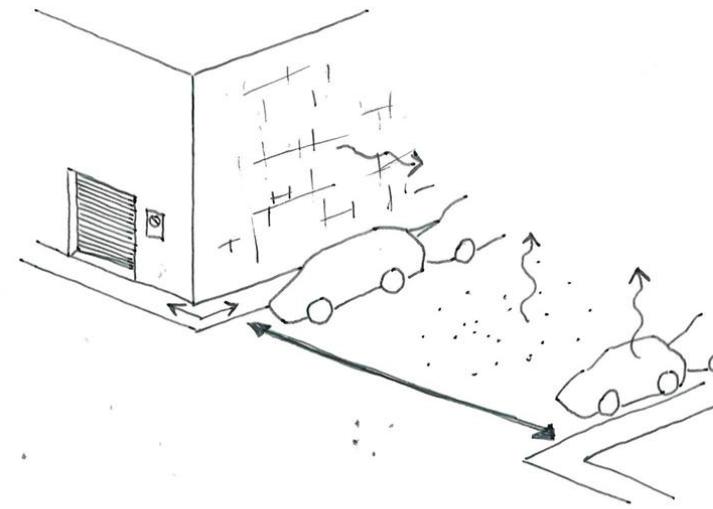
Conclusions

Here, the elements found in the neighbourhoods are shown again, divided into the ones that are desirable, not desirable, and those that are more complicated. These things are, for example, the bars before windows.

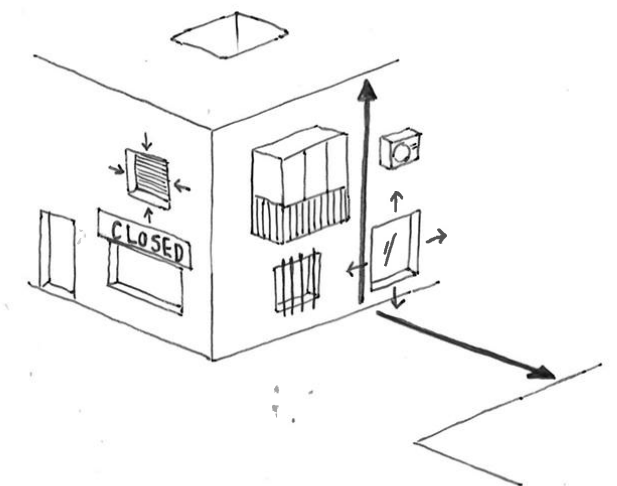
These do not look inviting, but is necessary if you want to leave the window open at night in order to cool down your home.



Desirable



Not desirable

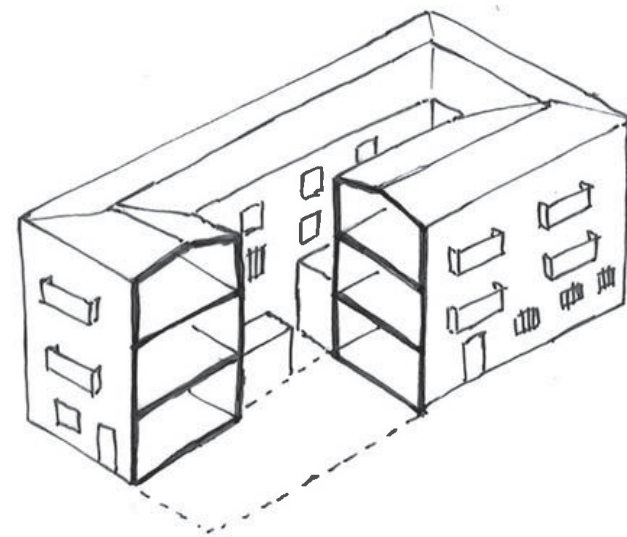


Thermal comfort and thermal conditioning potentially in conflict with each other

Looking at Pradolongo

Patios

Having mentioned courtyards, or patios, it is interesting to see their variety throughout the city. Pradolongo, because of its density, has smaller ones that are private. This is also because the building blocks are not developed as a whole. But where that does happen, courtyards become bigger and are shared. Still, it almost seems a rule that all courtyards are for residents only. It is like a pattern throughout the city of cool but non-common spaces.



Typical block Pradolongo

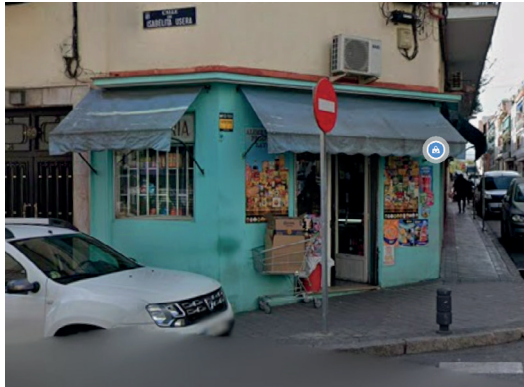


Non-public block interiors, evolving from Pradolongo to the other side of the river. They grow in size and dominance.

Looking at Pradolongo

Amenities

A variety of small businesses can be found spread throughout the neighbourhood's plinths. They vary in publicness; one could be a restaurant and another a car repair shop.



Different small amenities throughout Pradolongo.
From Google Maps (2026).

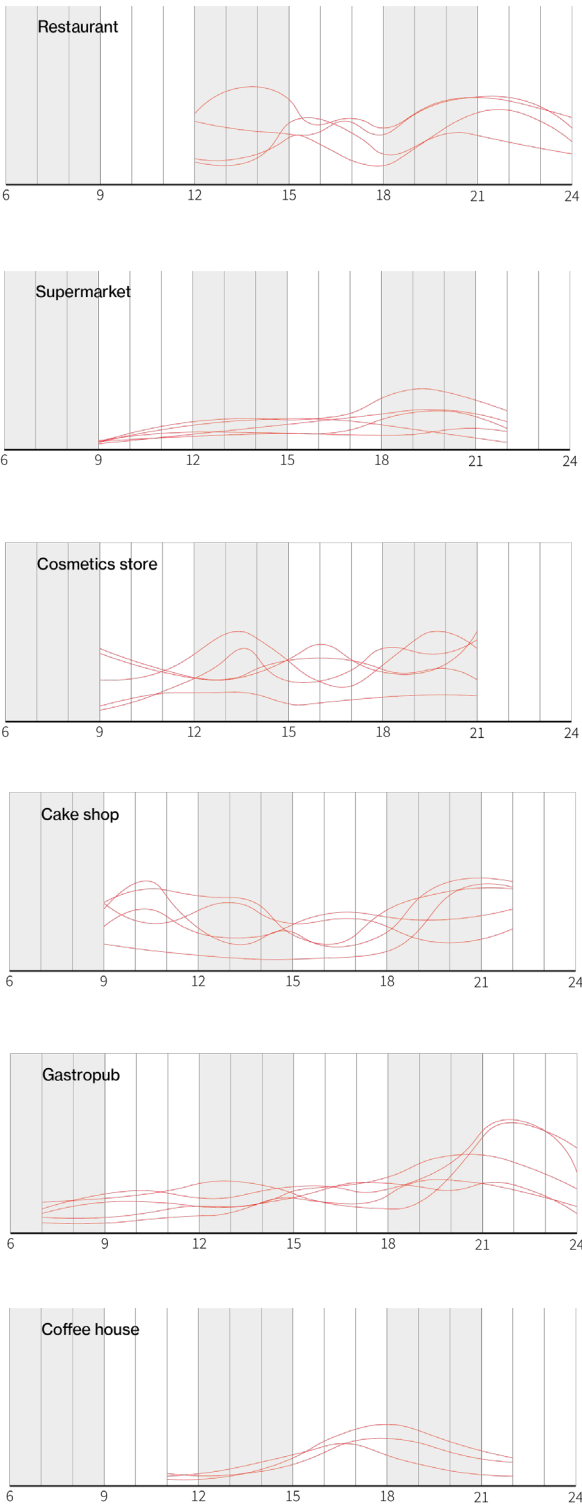


Adresses with registered opening hours in Pradolongo, mostly small buildings and scattered. Public facilities however, like schools, libraries or a police station, are clustered on the west side, outside of the dense area. Data retrieved from Google Maps (2026).

Looking at Pradolongo

Temporary accessibility

It is noticeable that the many amenities within the neighbourhood have different opening hours. It makes the 'public' landscape change throughout the day. Some businesses close around siesta time (around 16:00), but most of them do not. Many places are open until well into the evening. This allows for life to continue after the sun has set.



Different functions have different patterns of being visited throughout the day. Data retrieved from Google Maps (2026).



Open amenities at different times of the day and their temporary 'peripheries'. Data retrieved from Google Maps (2026).

Design concept

Introducing porosity

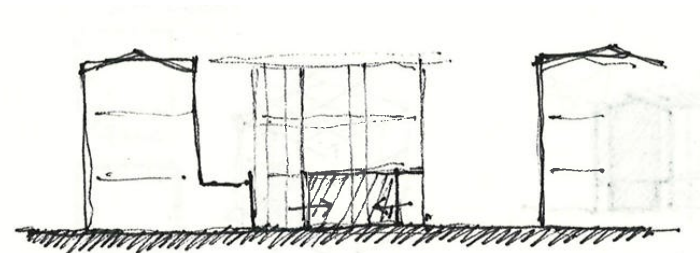
Is there space for thermal commoning in Pradolongo? Are cool spaces a common?

Between the building blocks, we find the public space. Within the building blocks, we find 'cool' space. The absence of a 'bridge' between these two hinders thermal commoning. Let's introduce a porosity suited to thermal commoning.

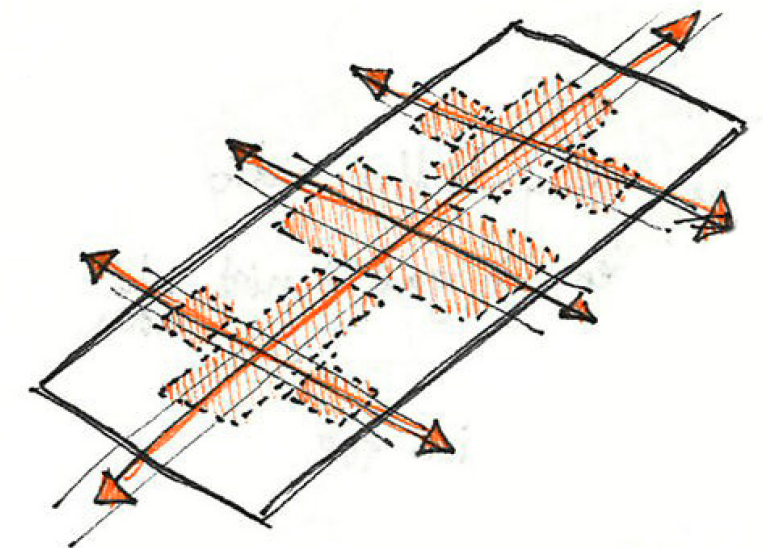
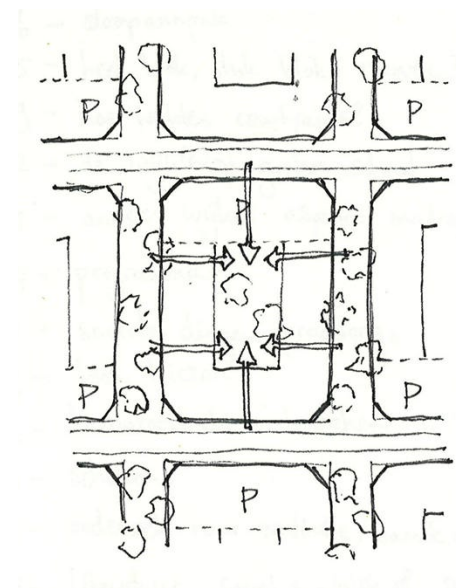
Porosity makes spaces merge. It creates transparency, accessibility, and flexibility. It can be applied at many different scales. From urban embedding, to layout, to routing, to materiality. A design tool that has the potential of being very useful for this project. It can connect the public space to the cool space and vice versa.



85 social housing units by Peris+Toral Arquitectes Cornellà de Llobregat (Barcelona). From "Rethink sustainability. 85 social housing units by Peris+Toral Arquitectes" (Metalocus, 2022).



The ground level as an entrance

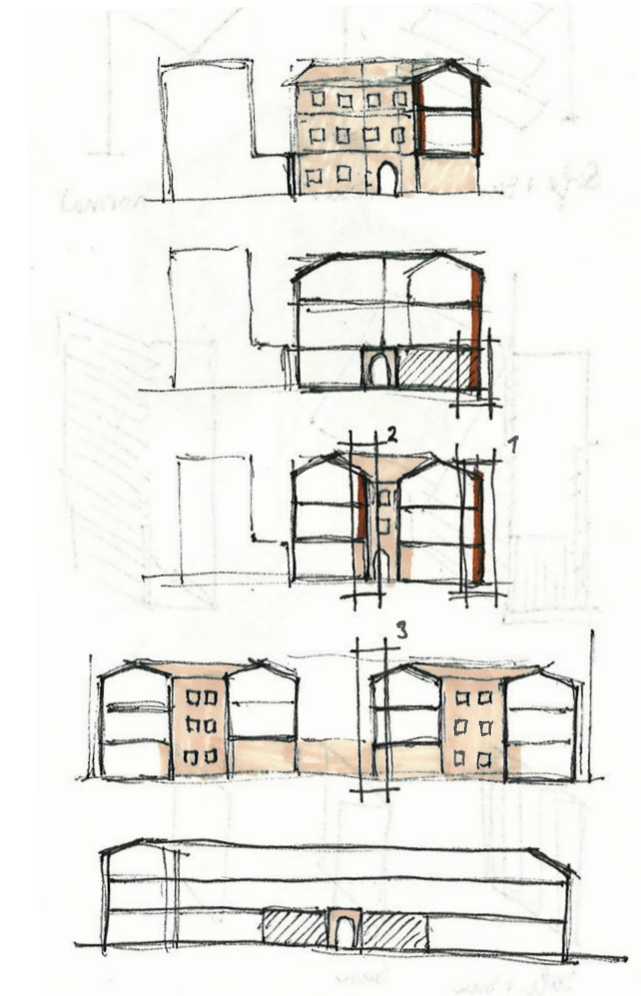
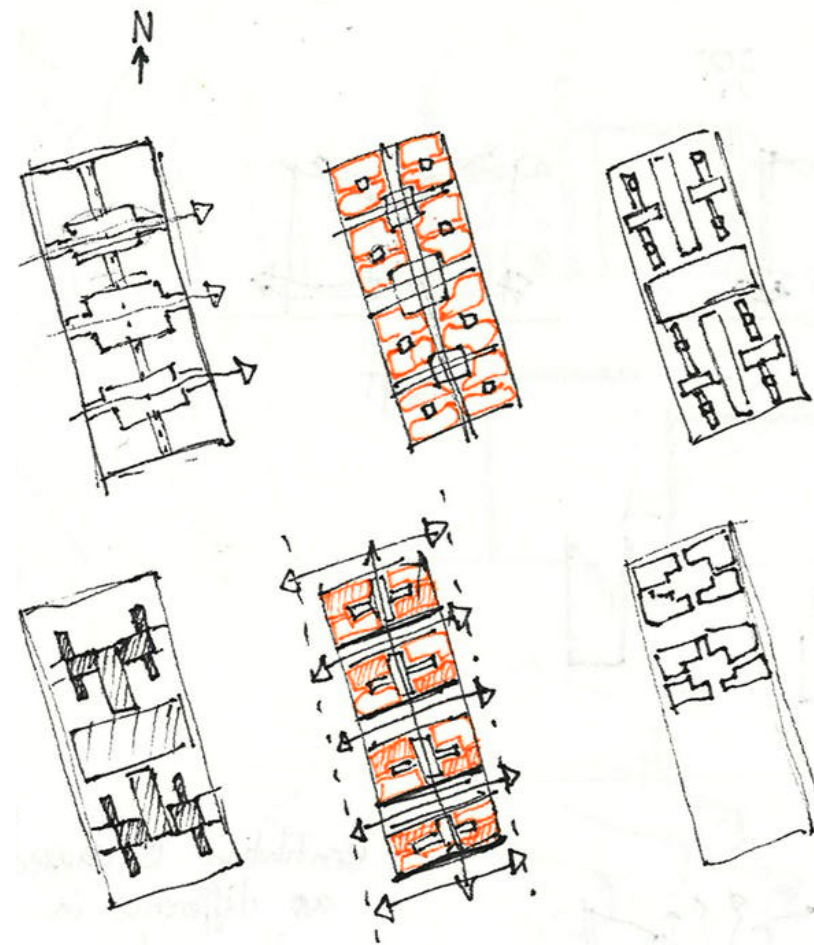
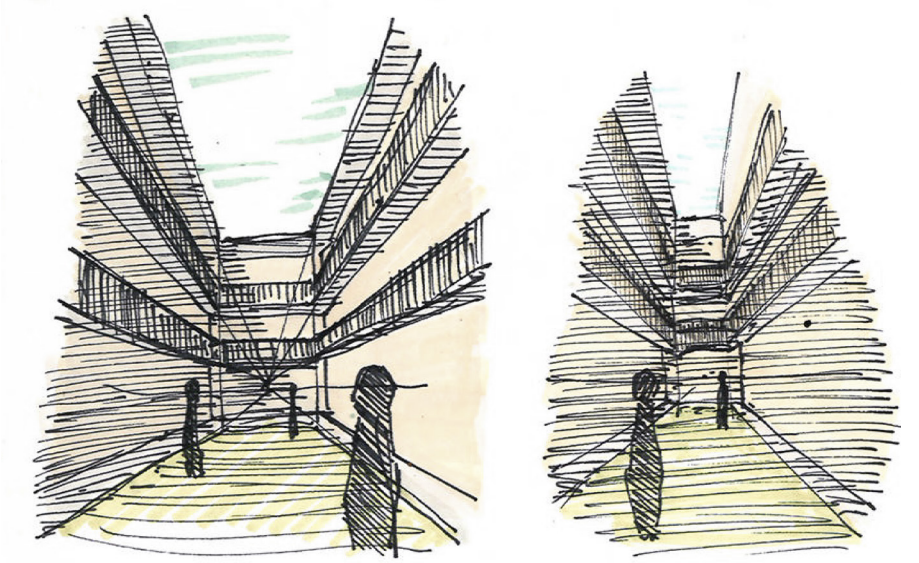
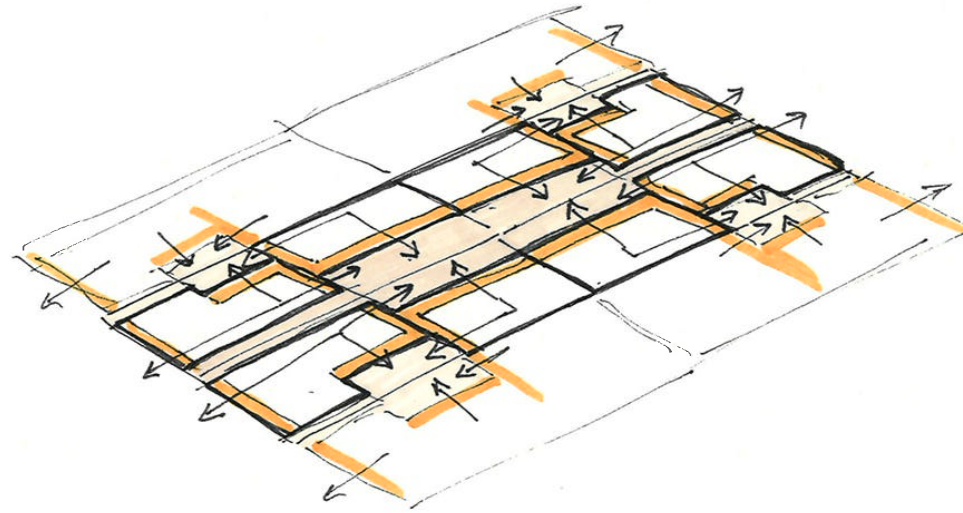


Opening up the patios

Design concept

Variety of spaces

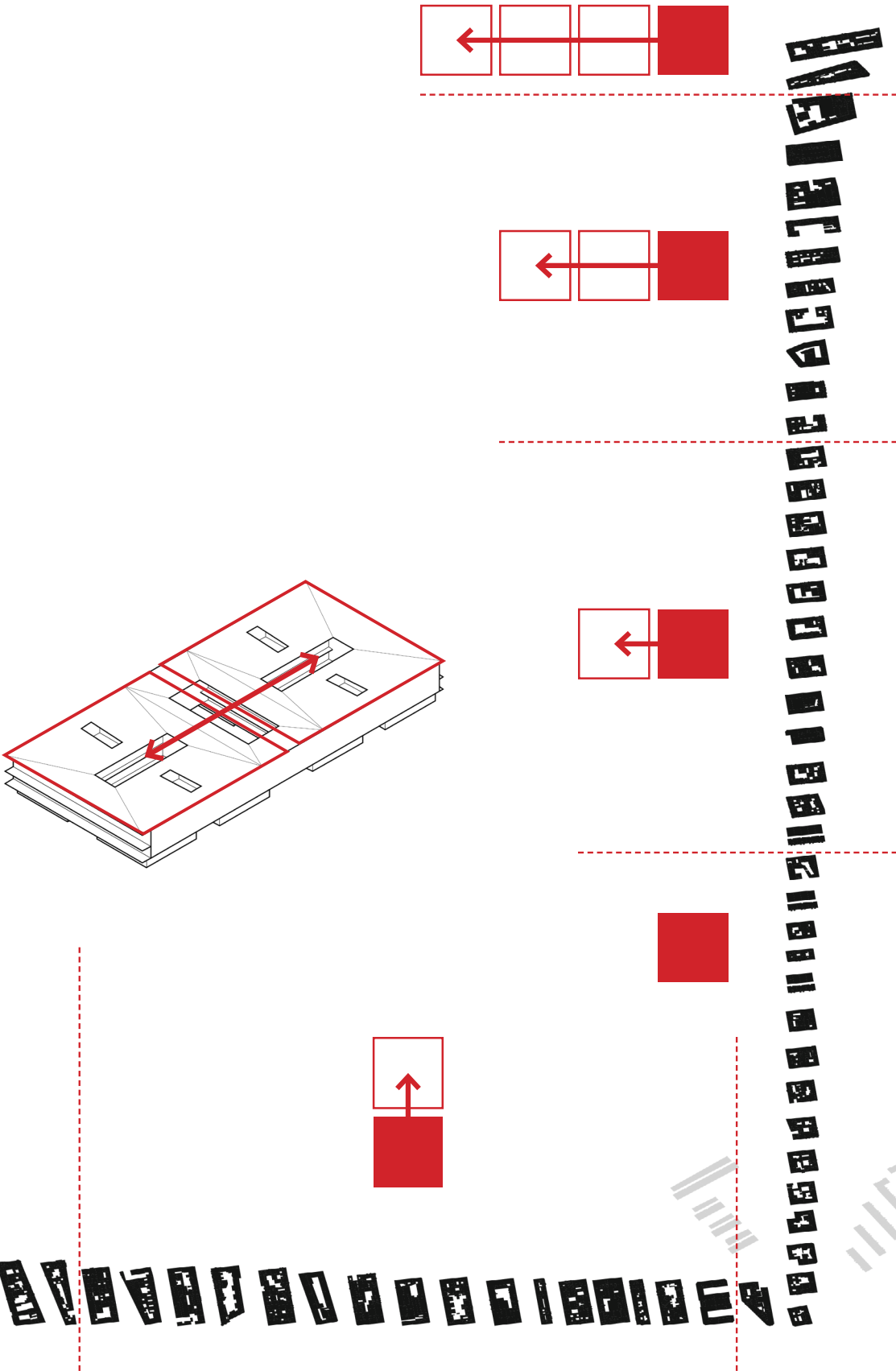
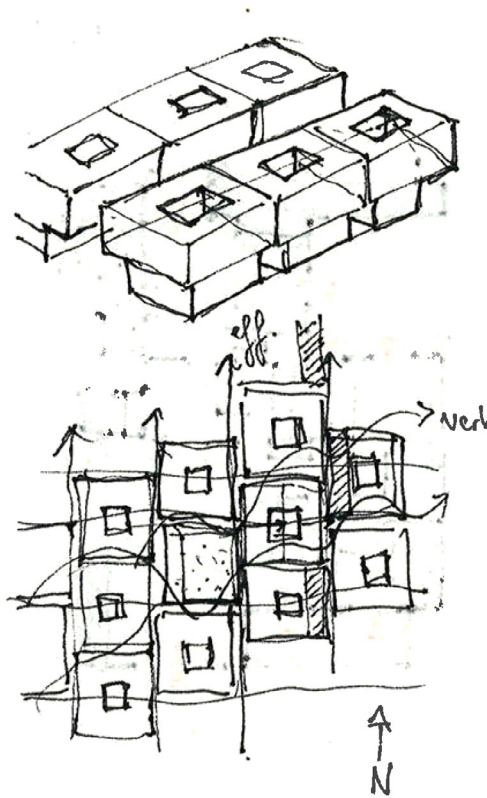
When breaking into these blocks, new spaces emerge. These should vary in intimacy and level of privacy. When connecting these in a meaningful way, the hard barrier discovered earlier can be broken down.



Design concept

Repeatability

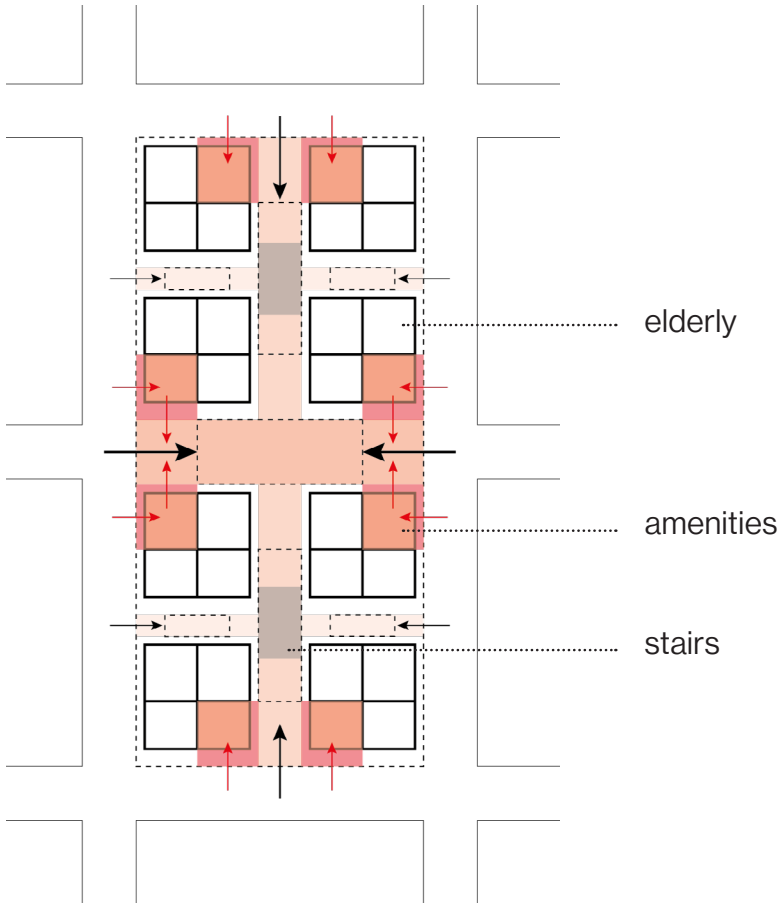
The concept is most valuable when it can be implemented throughout the neighbourhood. Here, the idea of a basic design unit is being explored. It can be repeated while considering the urban structure.



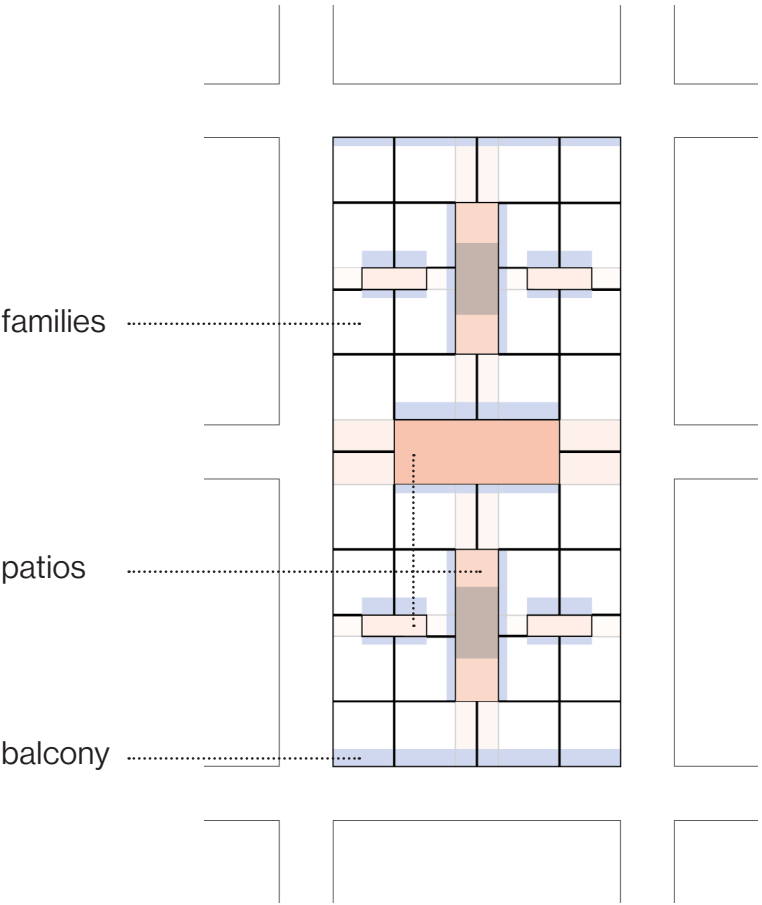
Design concept

Layout principle

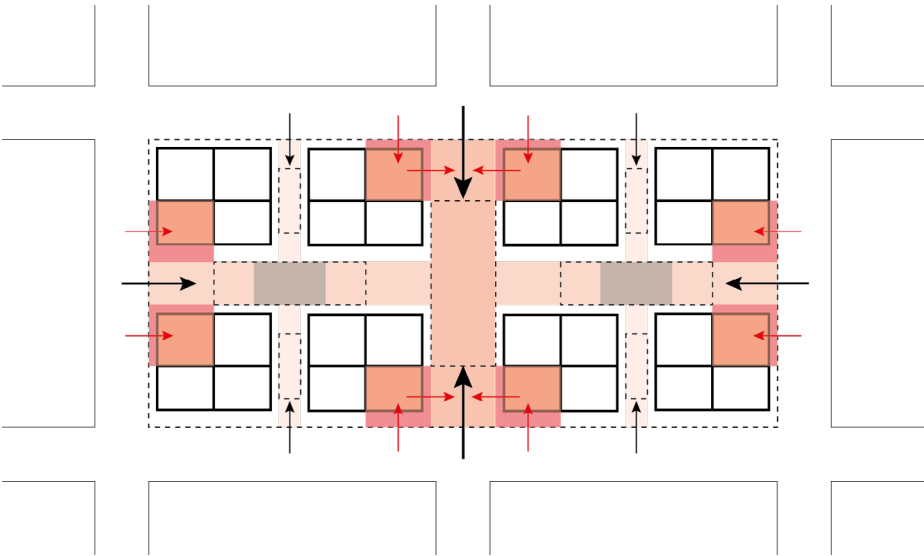
For this concept, two orientations are studied. On the ground level, amenities can be found at the main entrances of the block, activating the spaces. Senior housing is best located on the ground floor to facilitate interaction and accessibility.



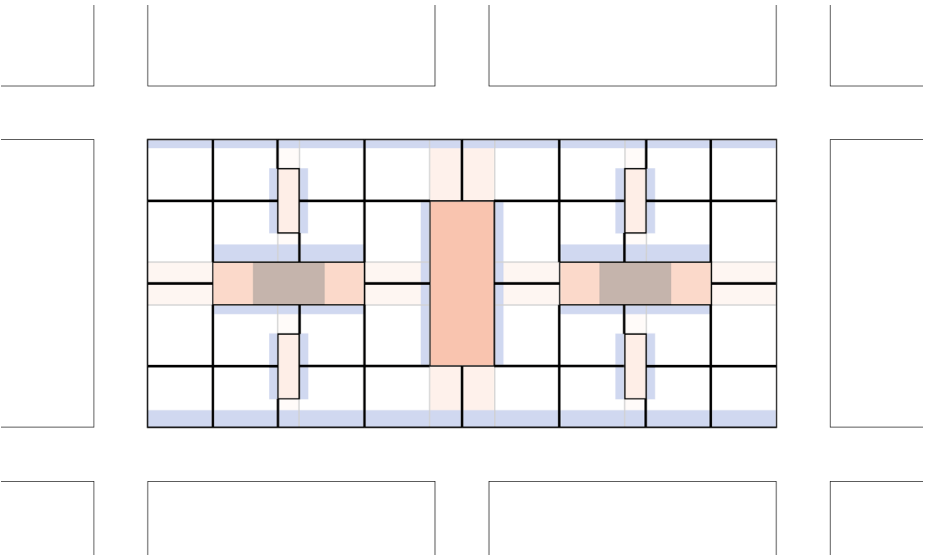
N - S oriented block
GROUND LEVEL



N - S oriented block
UPPER LEVELS



E - W oriented block
GROUND LEVEL



E - W oriented block
UPPER LEVELS

Design concept

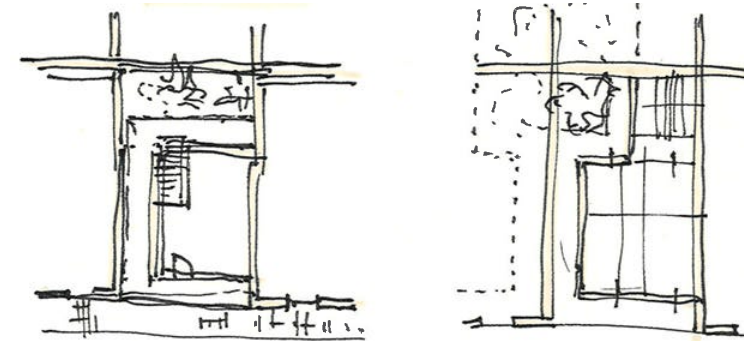
Integration: fragments

A number of vacant lots are found in the neighbourhood. It shows that the neighbourhood grows more organically, demolishing and building a new 'tooth' one at a time.

This gradual approach should also be considered in the design proposal. It is strong when it can be built one tooth at a time, with every tooth already benefiting the neighbourhood.



SARDENYA 356 Apartments / Aienza Maure Arquitectos in Barcelona. (ArchDaily, 2023).



How can a project be small yet accessible?



Vacant plots in the neighbourhood. Data retrieved from Google Maps (2026).



Experimentation with urban infill. Adapted from Google Maps (2026).

Design concept

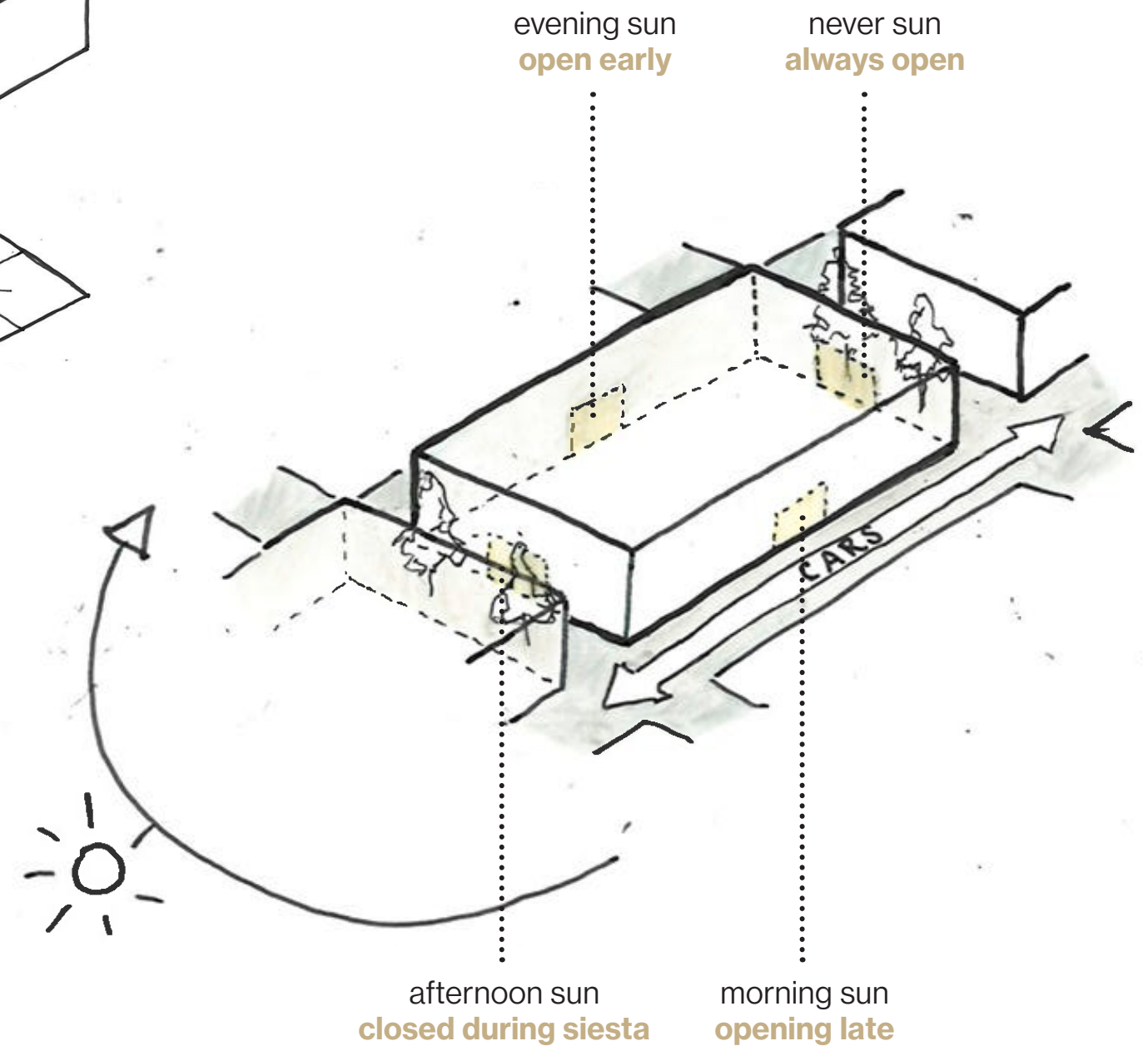
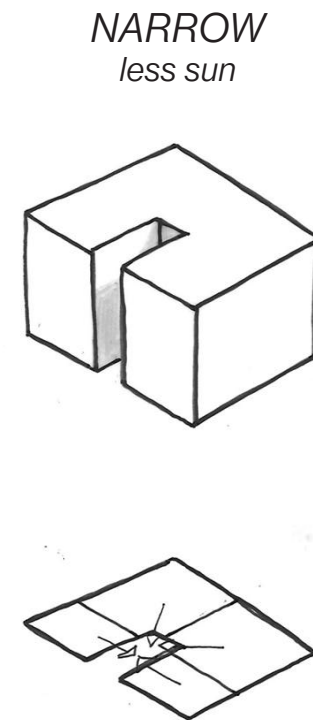
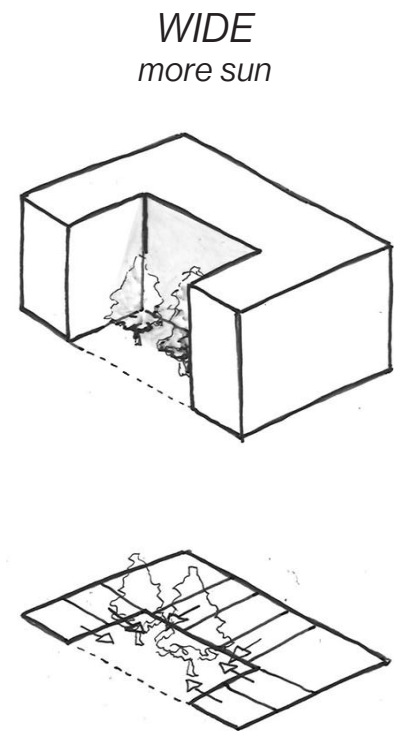
Sun exposure

Here, studies are done on how the block relates to sun exposure. Important aspects are the patio's size and orientation.

Big courtyards can be shared by many residents and allow for programming. But the dimensions cause sunlight to enter and therefore make the courtyard less cool.

The amenities placed at the entrances to the courtyard have different hours of sun exposure. Logically, each orientation should have its specific type of amenity with opening hours apart from the sun exposure hours.

The dominance of the car should be limited; roads are reduced to only one axis instead of two. This axis will be the one with the most sun exposure, since it will be used less by pedestrians.



Design concept

Facades: closed or open?

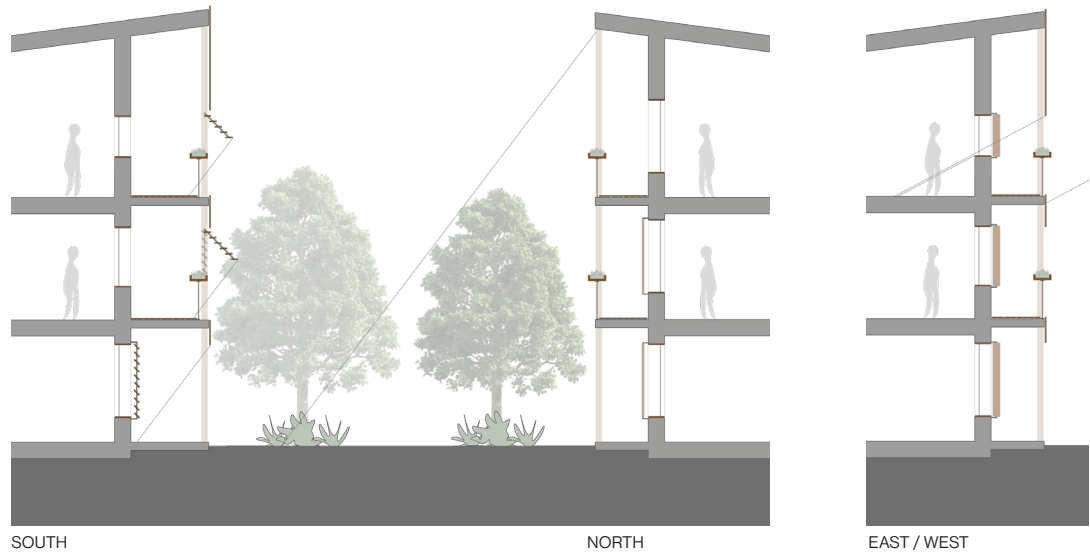
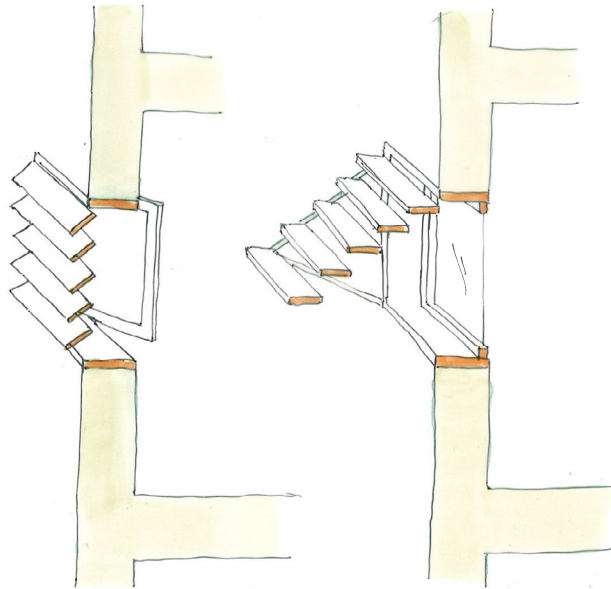
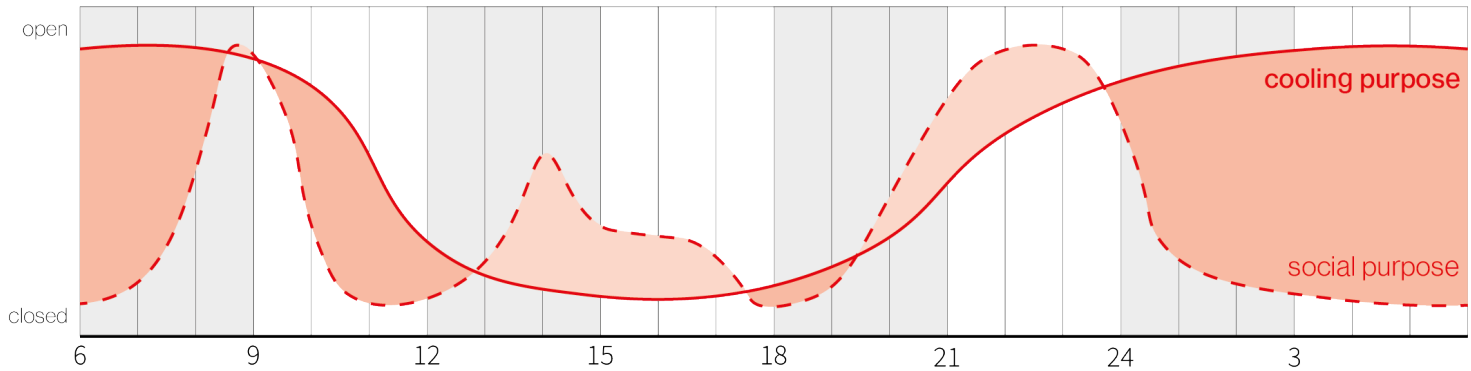
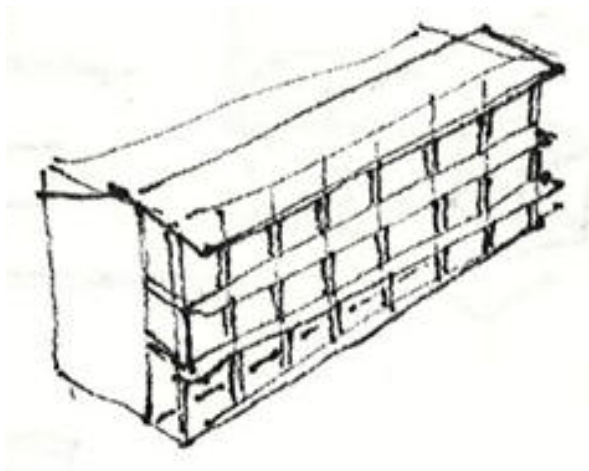
Balconies not only protect the facade from direct sunlight, but they can also function as an in-between zone, reducing the hard public-private barrier. As mentioned before, the sunshading dilemma remains.



Social housing 1737, Barcelona. (H ARQUITECTES, n.d.)



From Google Maps (2026).

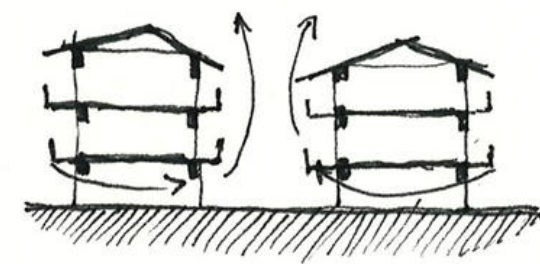


Design concept

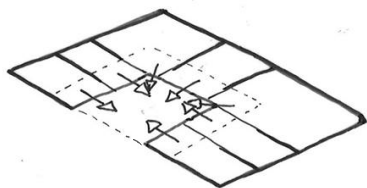
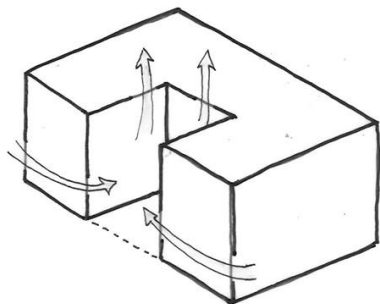
Patios and ventilation

Courtyards do not only have a social function, but they are also useful for climate control (Diz-Mellado, 2023). They allow warm air to rise during the day, cold air to go down during the night. When putting courtyards of different temperatures next to each other, air flows from the cold one to the warm one.

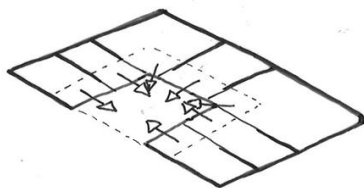
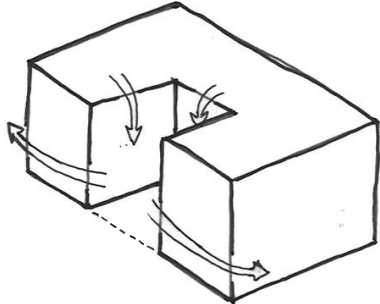
This gives the project a functional porosity, going from the courtyard to the street. Of course, this cooling method is not always usable, but mainly during nighttime, it can be very helpful.



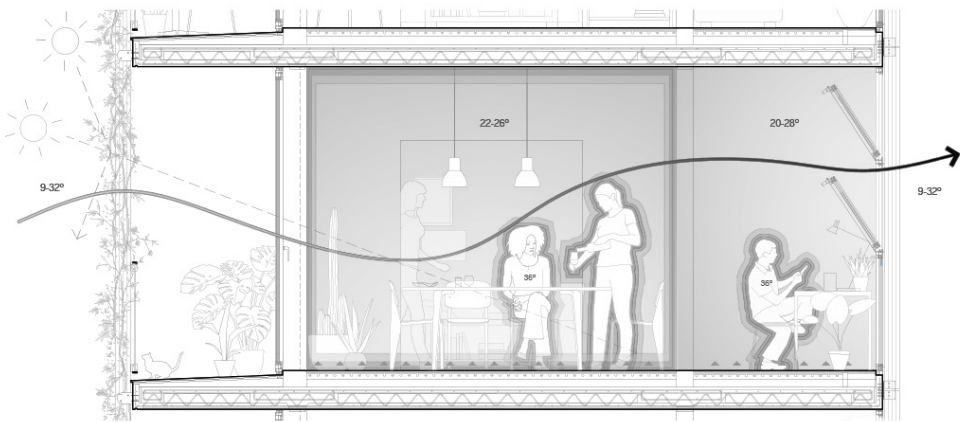
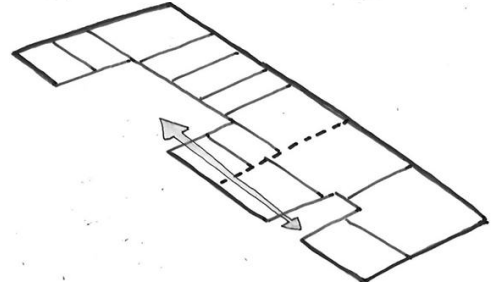
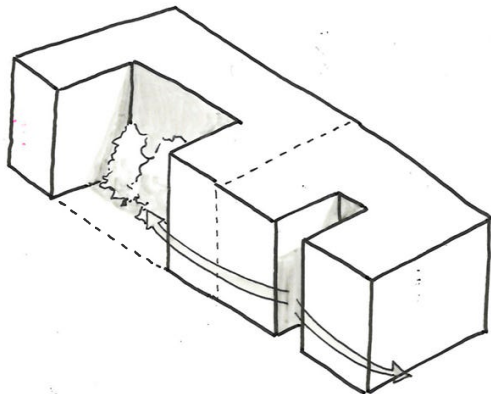
DAY



NIGHT



DIFFERENT SIZES



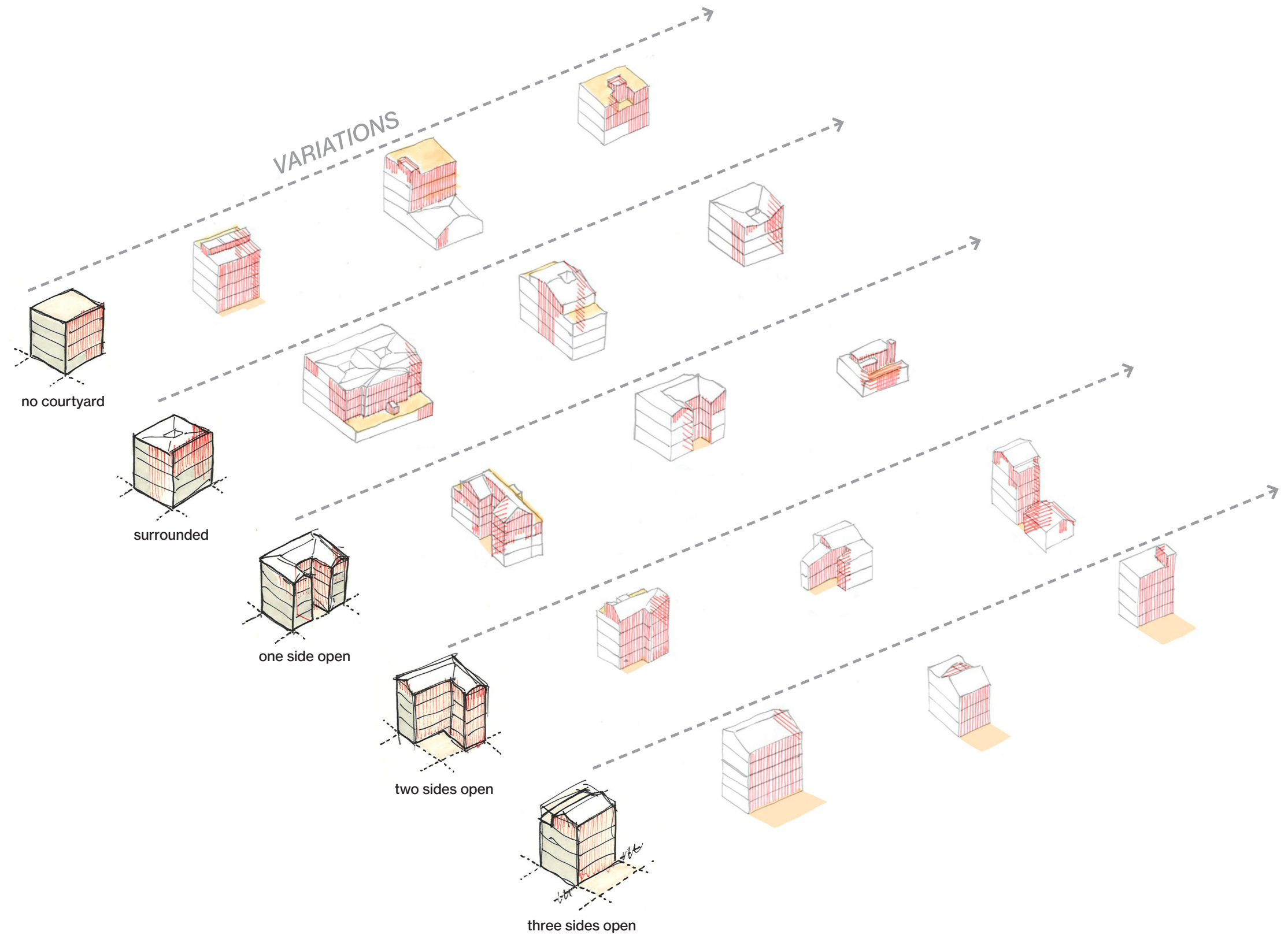
Social housing 1737, Barcelona. (H ARQUITECTES, n.d.)



Design concept

The neighbours

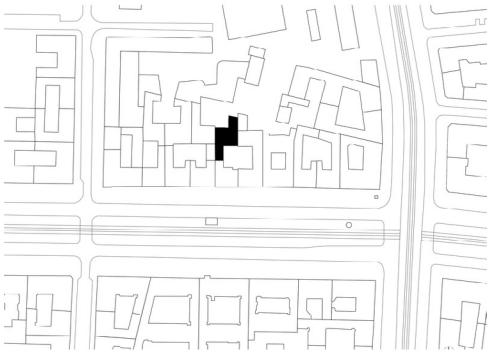
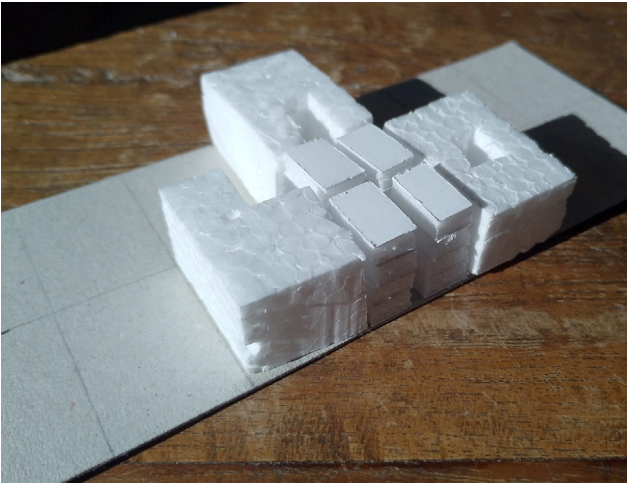
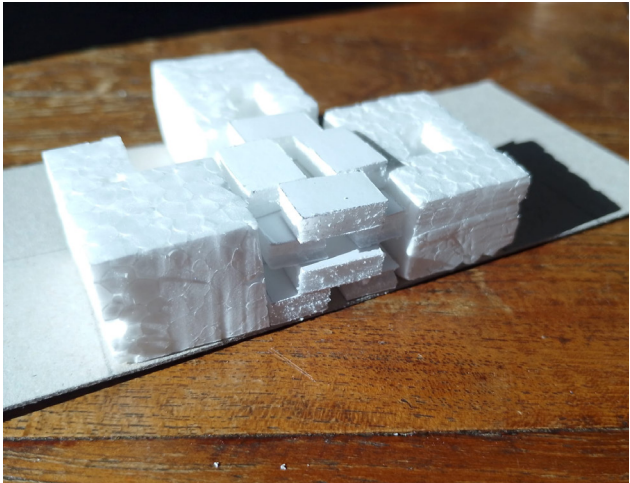
Throughout the neighbourhood, a wide variety of building shapes can be found. Most of these buildings have some form of a courtyard or an outside space on the interior of the block. Five different building types can be distinguished, all relating to their courtyard differently.



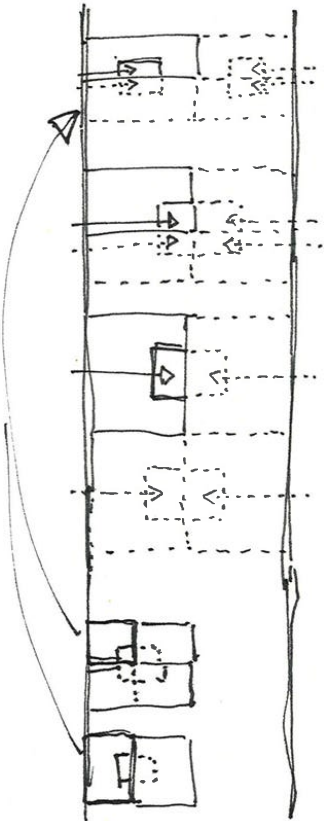
Design concept

Responding to neighbours

The project wants to be able to ‘fit’ next to all these different building shapes. At different locations, the project will meet different plot sizes, orientations, and shapes. The neighbouring building could be small, large, open, or closed. Therefore, there is room needed for flexibility, while keeping the practical benefits of standardization.



Urban Infill Berlin, by Appels Architekten. From “Press kit no. 6863-02” (v2com pr + newswire, n.d.).



Developing design

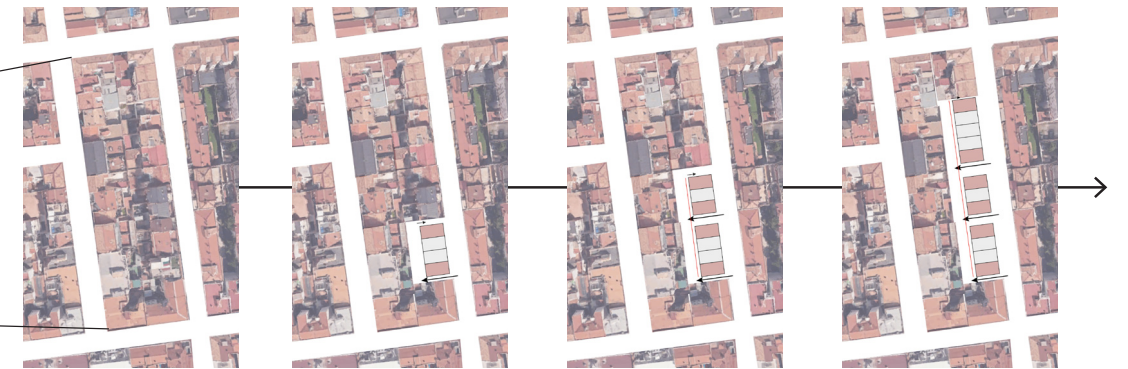
Phasing

A building block is chosen as a site of intervention, functioning as an example. The block is located at one of the two 'periphery' areas, amenity-wise. It would make sense to start this catalyst for thermal commoning here.

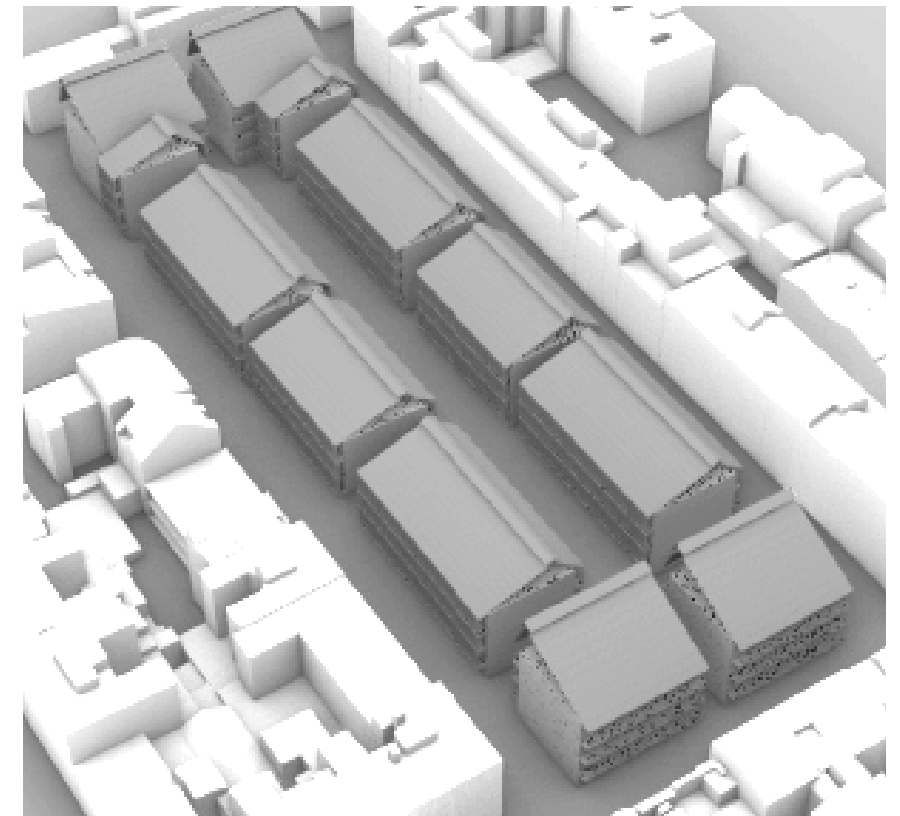
As can be seen, the block can be developed in parts, leaving some space in between. This is for two reasons. Firstly, these can form the 'gateways' to the courtyards. Secondly, they function as a buffer zone to allow for flexibility regarding plot sizes and different adjacent facades.



Temporary peripheries layered on top of each other give two points of interest.



How could this block be transformed, hypothetically?



Developing design

Gateway

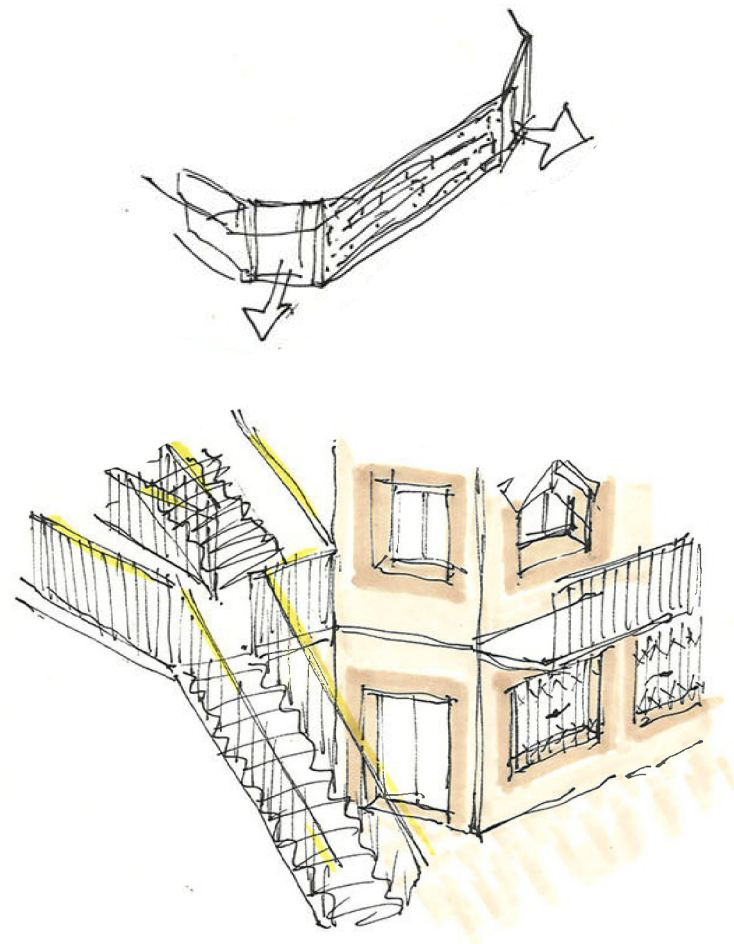
These gateways represent the porosity principle of the project. With the amenities here, the space gets activated and becomes an inviting transition zone. Logistically, the space allows for vertical movement.

The porosity is also shown in the plinths, being semi-transparent brickwork. Besides the aesthetic benefit, it also has a practical benefit. This part of the project is open to the public, also at night, therefore burglar protection is needed.

At the centre of the gateway, a 'pavilion' can be added that is used (and airconditioned) by the amenities during opening hours. This leaves the space cooler throughout the rest of the day, when it can be used by residents as a climate refuge and social space at the same time.

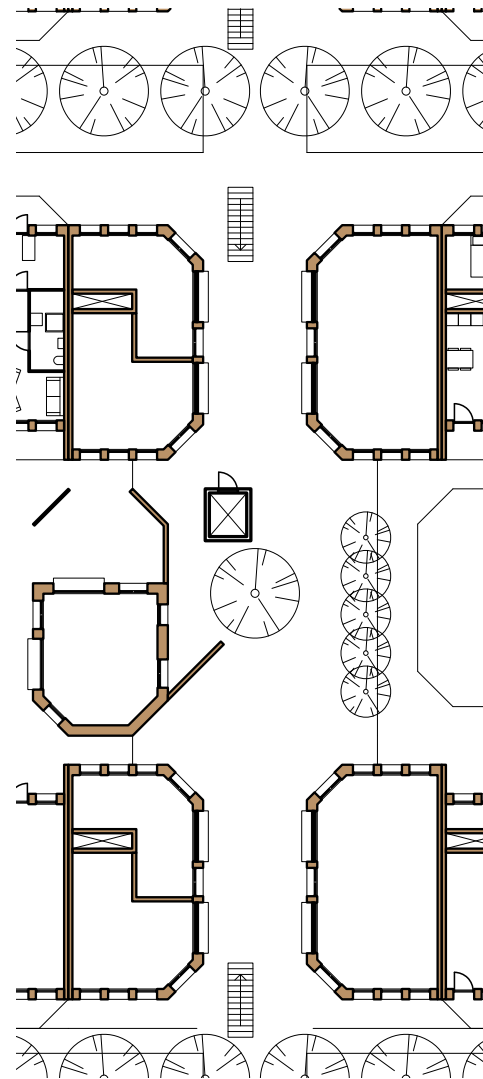


Semi-transparent brick facade. From "Hooba Design Group wraps Tehran office in glass-punctuated bricks" (dezeen, 2020).

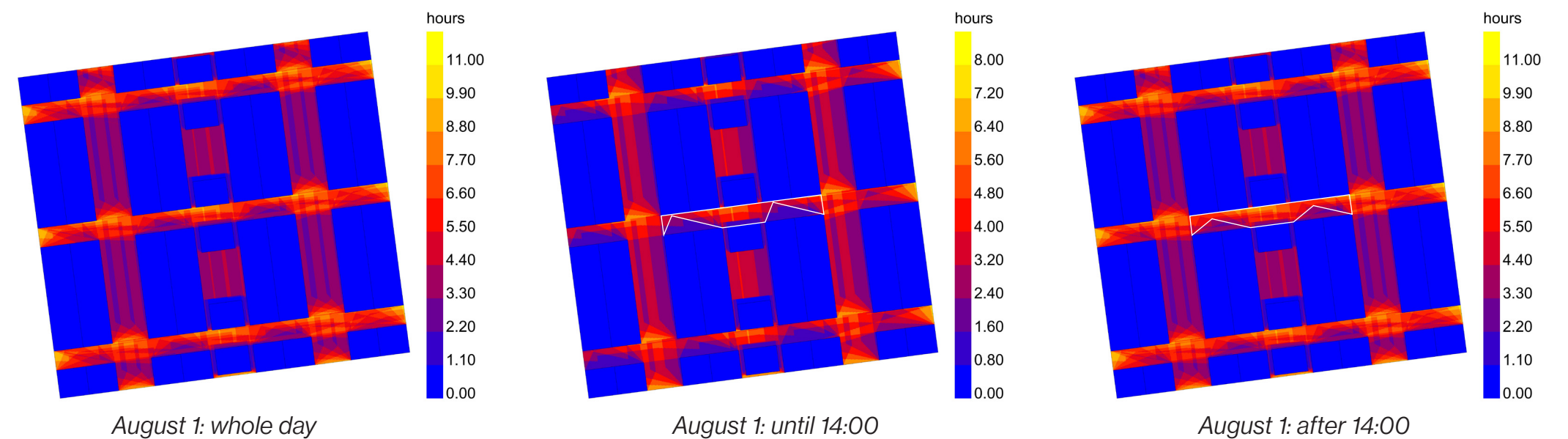
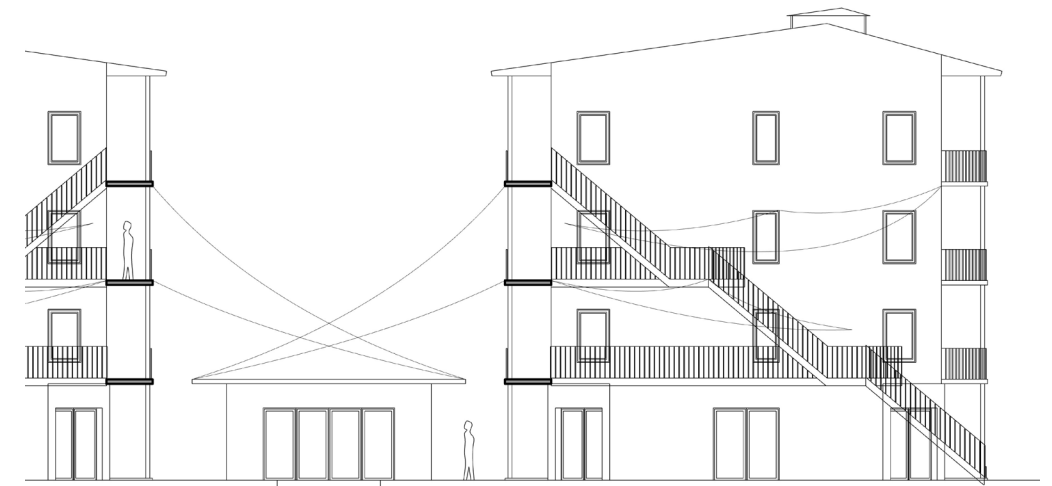


Since the gateway hopes to promote a thermal commoning, the cooling part should not be forgotten. Some form of sunshading is needed, but it has to be flexible. The buildings are not built at the same time, so it needs to be removed / changed / added on. This is also because it needs to get out of sight when not needed, so as not to permanently block the view.

Polyethylene shades are flexible and simple. It can be placed and removed manually, encouraging conscious community involvement. When summer is over, it can be removed.



Shading. From "Shade Structures for Outdoor Spaces: 6 Tips to Incorporate Into Your Next Project" (ArchDaily, 2019).



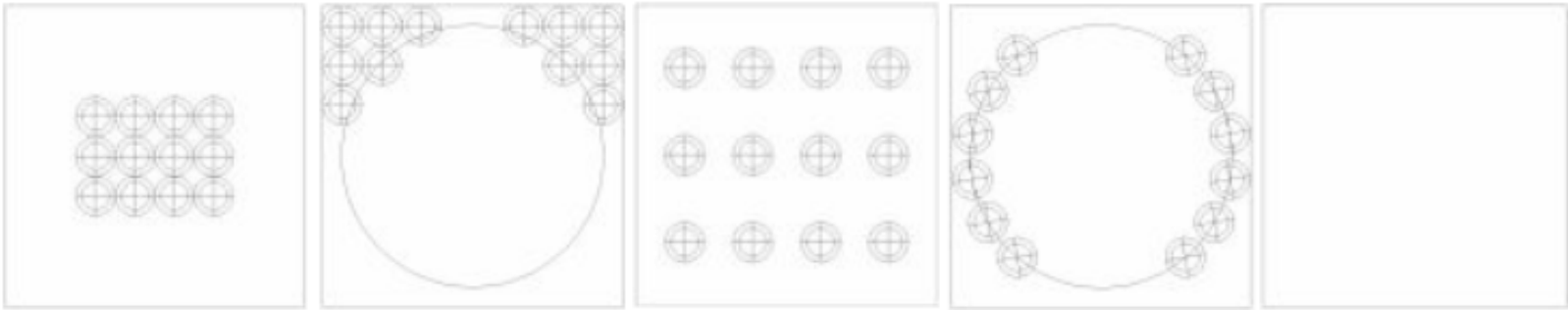
Direct sun hours studies. Created by author using Rhino Grasshopper (2026).

Developing design

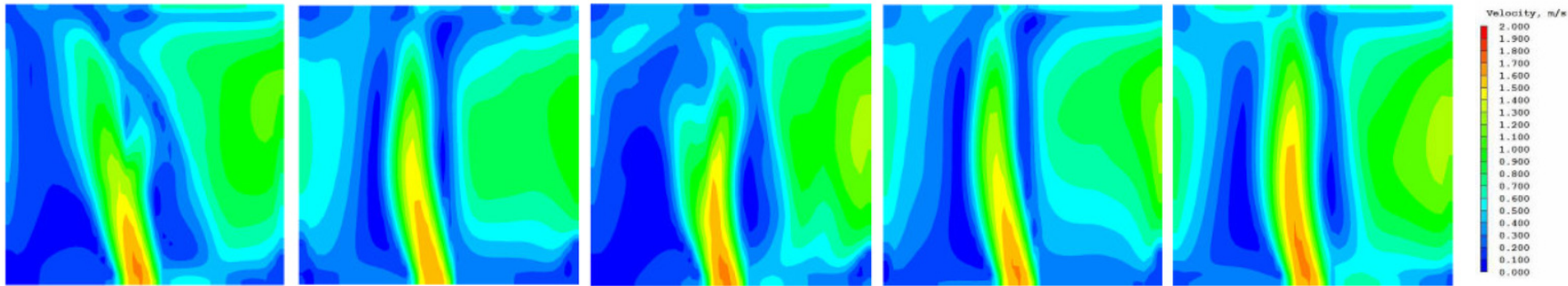
Patio

The patio, however, should not be covered with sunshading. Exposure to the sky is essential in order for the patio to do its work. Another requirement of the courtyard to work is that the openings (the gateways) should be at least 4 times as small as the courtyard itself (Chahal and Aulakh, 2018).

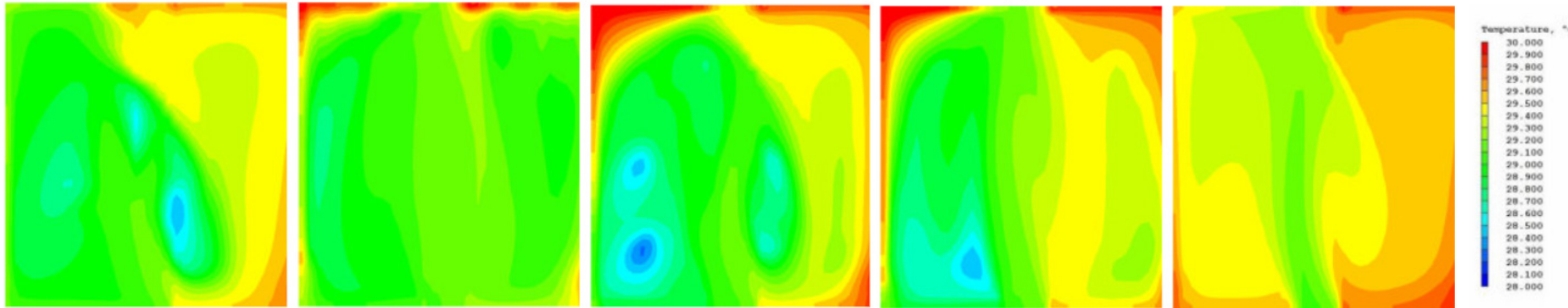
In addition to that, the use of water elements and trees further help keep the temperature down.



tree arrangement



wind velocity



air temperature

Impact of tree arrangement on wind velocity and air temperature in courtyard. Adapted from Li et al. (2019).

Streets

The car is being removed from the axes with the least amount of sun exposure. Here, room for greenery is created. However, greenery needs water. And in Madrid, there is not enough rain to maintain it. To limit the demand for water, greenery is only planted at strategic spots. Still, a positive climatic effect is expected: street trees can reduce the need for heating and cooling energy use by up to 25%. (Vale, 2023).

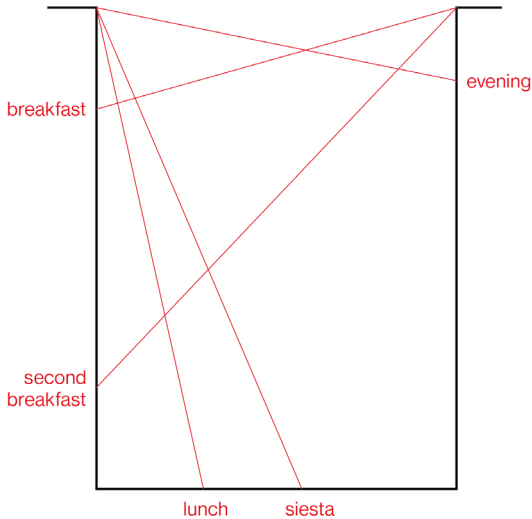
For the trees, raywood is used. It is widely used in the Mediterranean, grows fast (not too big), and doesn't need much space or water to grow (Van Den Berk Boomkwekerijen, n.d.). Another benefit is that it loses its leaves during winter, which allows for more sunlight and a view of the street.



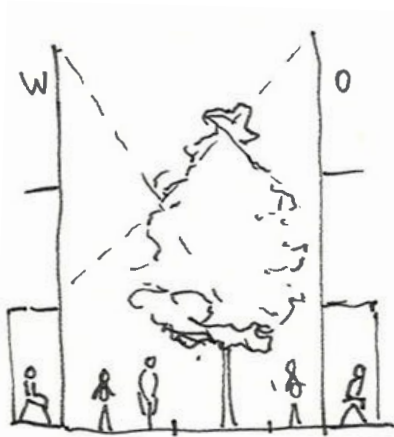
A raywood tree. From "Fraxinus angustifolia 'Raywood'" (Van Den Berk Boomkwekerijen, n.d.).



The sun pattern of Pradolongo on August 1. Created by author based on information from suncalc.org. (2026).



Sun exposure in the streets of Pradolongo on August 1. Created by author based on information from suncalc.org. (2026).

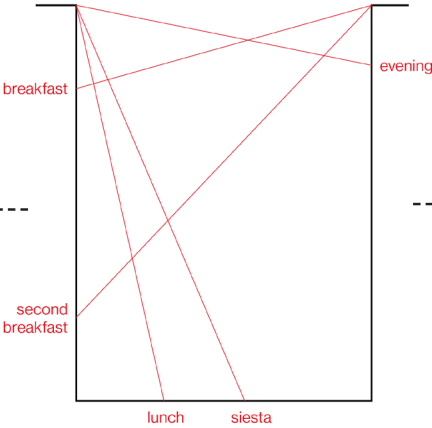


Developing design

Amenities

The amenities can be located on either the west side or the east side of the block, depending on which time of the day they are visited most. Here are some amenities as an example.

The project does not focus on the north and south orientation, but on the hot south side parking space, which is best suited, and places that are busy during dinner and later, like restaurants or cafes. On the cooler north side, spaces like farmacies and businesses spread throughout; they make more sense.



Sun exposure in the streets of Pradolongo on August 1. Created by author based on information from suncalc.org. (2026).

WEST



LUNCH | BAR JUNEJO
Bar | C. de Isabelita Usera, 53



SIESTA | LA WASH
Laundromat | C. de Dolores Barranco, 80



SOCIALIZING | STRAGOS CAFÉ BAR
Cafeteria | C. de Isabelita Usera, 45

Data and images retrieved from Google Maps (2026).

EAST



BREAKFAST | EL ENCUENTRO
Coffee bar | C. Mariano Usera, 13



SECOND BREAKFAST | ELECTRO WORLD
Electronics store | C. de Marcelo Usera, 90

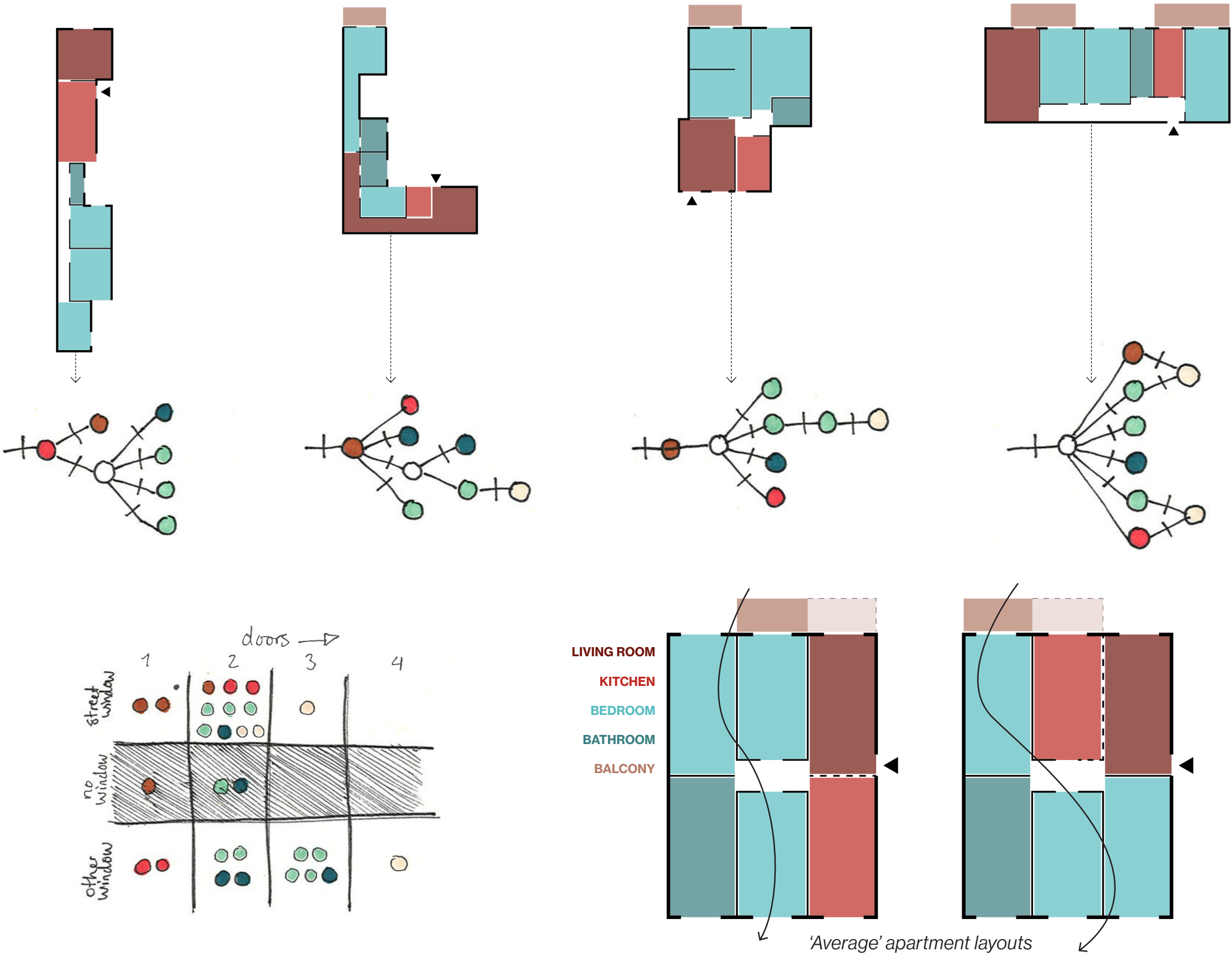
Data and images retrieved from Google Maps (2026).

Dwellings

To be informed on a realistic dwelling floor plan design, average (in price and m2) homes currently for sale were studied. A conscious addition was the possibility for cross ventilation during the night by putting bedrooms on opposite sides of the apartment. In regard to ventilation, the use of an air shaft was considered, but this, however, did not work well together with the roof's ventilation system. Besides, airshafts have a negative impact on temperature, visual privacy, sound privacy, and smells (Alzah-rani, 2022).

Created by author based on information from Idealista (2026).

Analysed apartments:

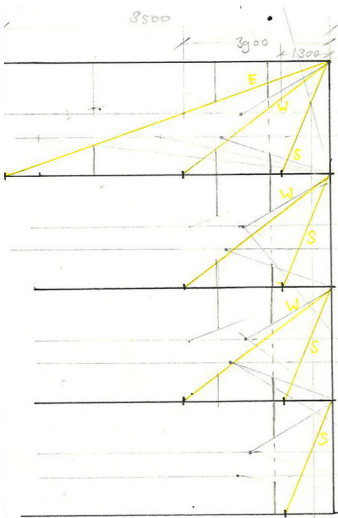


Balconies

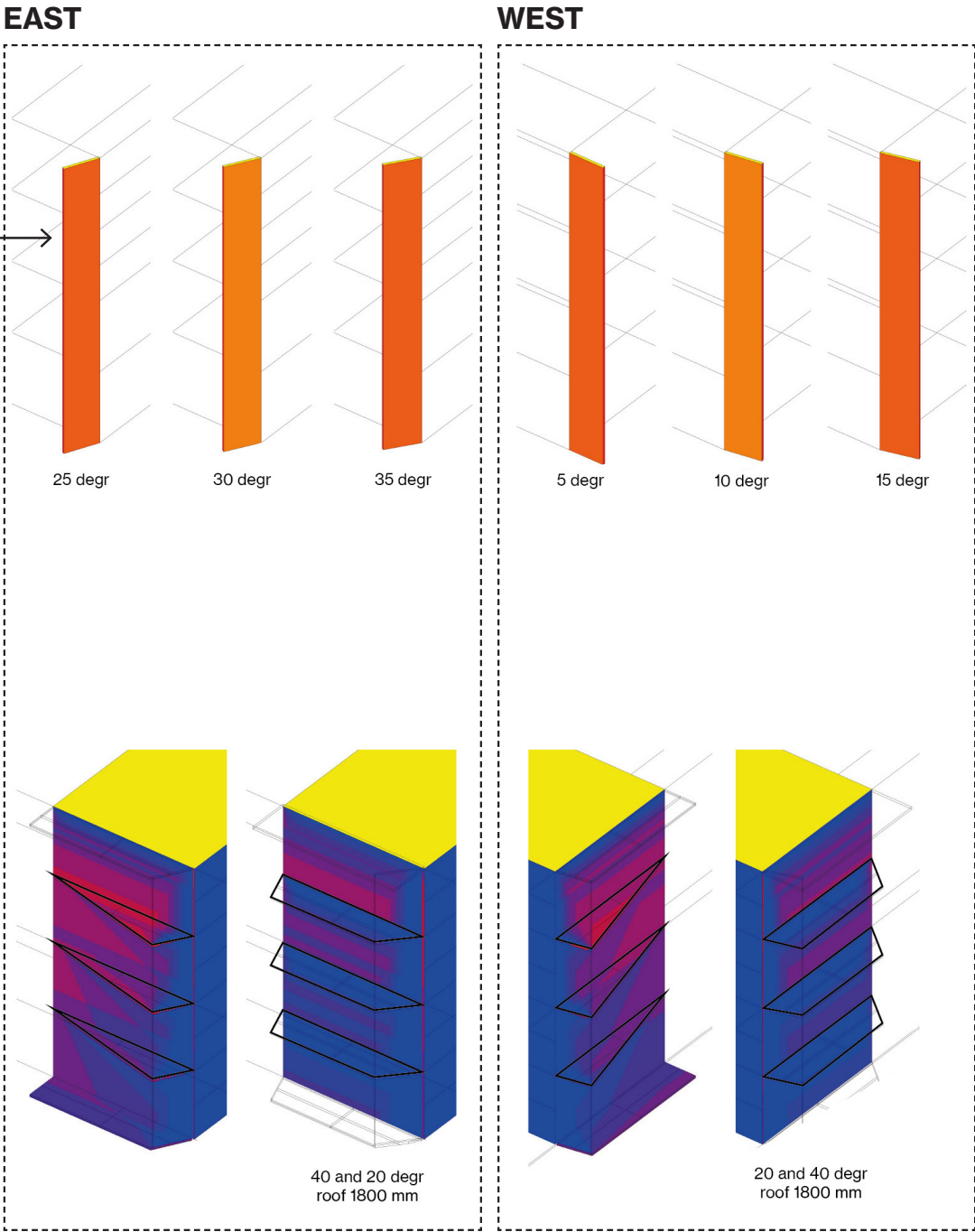
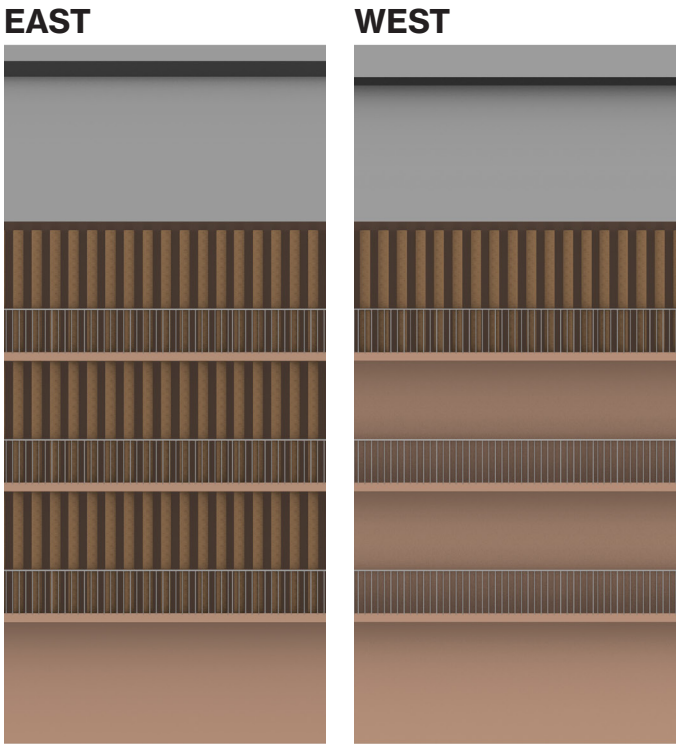
The balconies need to protect the facade from direct sunlight. Because it is an east-west orientation, movable vertical louvres are an initial thought. They are only needed on the higher floors, since the sun exposure on the lower parts of the streets is minimal.

A downside to this is that the facade is still very closed when the louvers are used. Another approach is using one big sun screen on one side of the balcony, targeted at the right angle.

Since balconies reduce the opportunity for natural ventilation inside the home (Loche et al., 2024), the area of the balcony should be minimized. Studies are done on how to still shield the facade.



Expected sunlight penetration on August 1. Created by author based on information from suncalc.org. (2026).



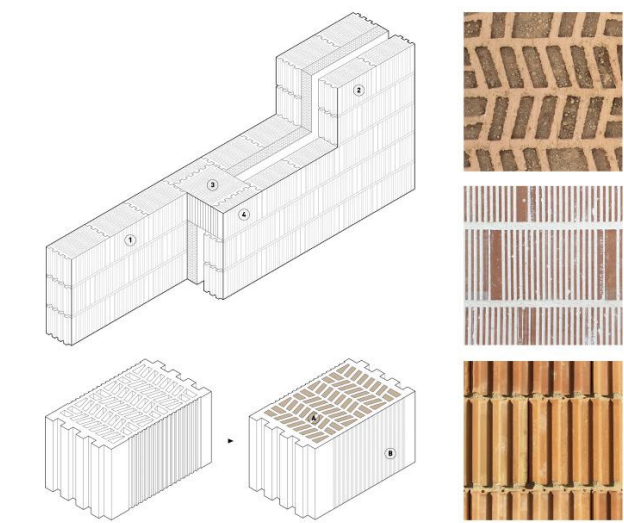
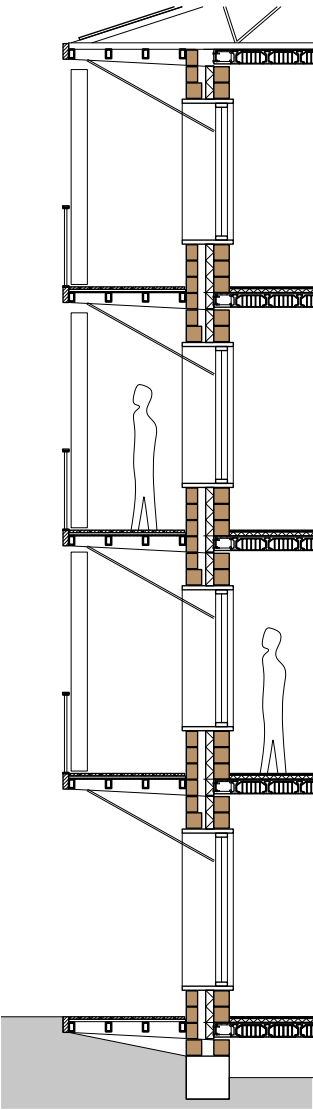
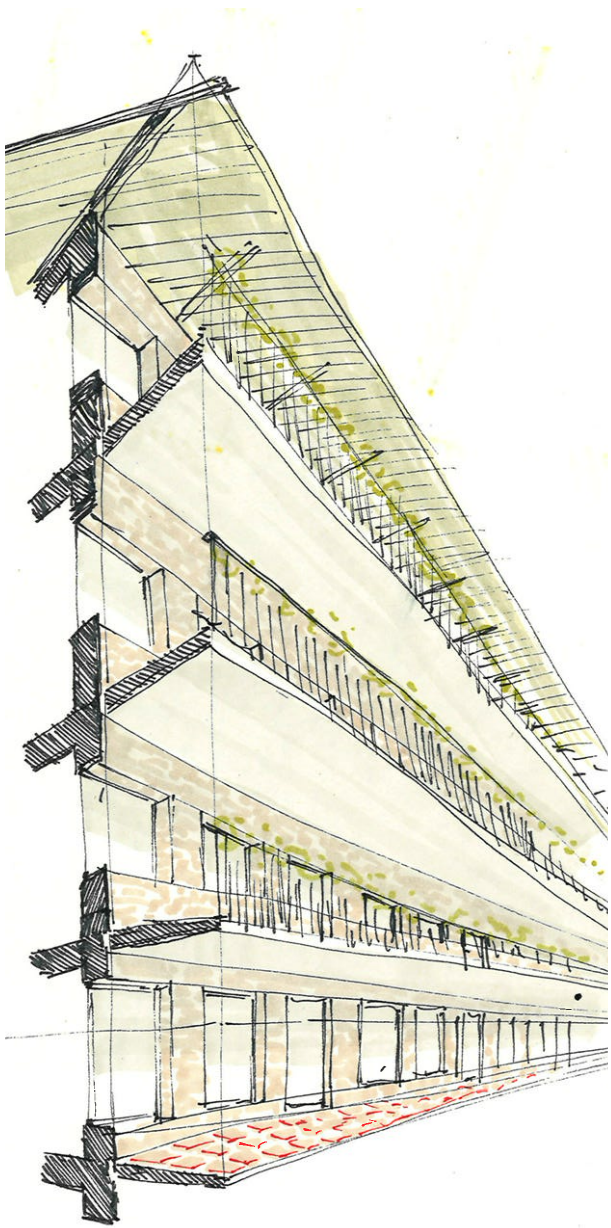
Direct sun hours studies. Created by author using Rhino Grasshopper (2026).

Developing design

Facade

The facade will use the benefit of thermal mass by using thermo-clay blocks, as used in the reference on the right. It will be load-bearing. An ambition of the building's exterior is to look inviting and friendly, despite its mass and smaller windows. A gently textured material such as brick is therefore suiting. Besides, it is also seen throughout Pradolongo.

It is possible to vary in finishing and positioning, allowing for variation in the facade. It can also show porosity by laying bricks on their side. This will be used to emphasize the vents in the facade. This aesthetic will correspond with the materiality of the gateway.



FACADE DETAIL
1 interior structural leaf of 19cm thermo-clay | 2 exterior leaf of 14cm thermo-clay | 3 29cm thermo-clay block to join both leaves | 4 half a block of 14cm thermo-clay
A thermo-clay block filled with excavation soils to increase its thermal inertia | B thermo-clay block plastered with lime mortar for the chamber waterproofing

Social housing project emphasizing qualities of thermal mass, Ibiza. "24 Public Dwellings in Platja d'en Bossa" (Divisare, 2022).

Developing design

Floors

Viguetas and bovedillas is a widely used flooring type in Spain, especially in residential projects. Therefore, it is affordable, considering its minimal material use. It combines hollow ceramic bovedillas with reinforced concrete. It cannot span more than 10 meters, but that is not a problem since the dwelling units span only 6.

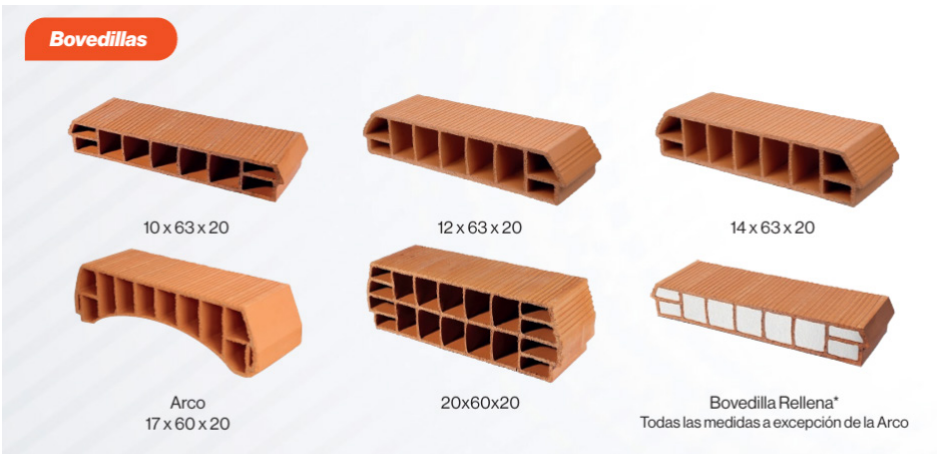
There are some practical benefits to using this system. It consists of many smaller elements and doesn't need extensive formwork or large machinery.

The floor system is compatible with floor heating, and it can carry ceramic partition walls (although some extra reinforcement is needed in the concrete layer locally) (Tensolite, n.d.).

Bovedillas made of concrete also exist, but the elements are heavier, and let through more heat and sound. (Harmak, n.d.)



The floor system before pouring the concrete. From “Innovaciones en el Sistema de Vigueta y Bovedilla de Barro” (El Heraldo, 2023).



Variety of bovedilla sizes. From Ficha Técnica Vibo 2025 - 2 (Ladrillera Mecanizada, 2025).



Integrating floor heating in the floor system. From “Suelo de vigueta bovedillas MILLIWATT” (Archi Expo Connect, n.d.).



Process of building the floor. From Vigueta - Bovedilla Guía de Instalación (Ladrillera Mecanizada, n.d.).

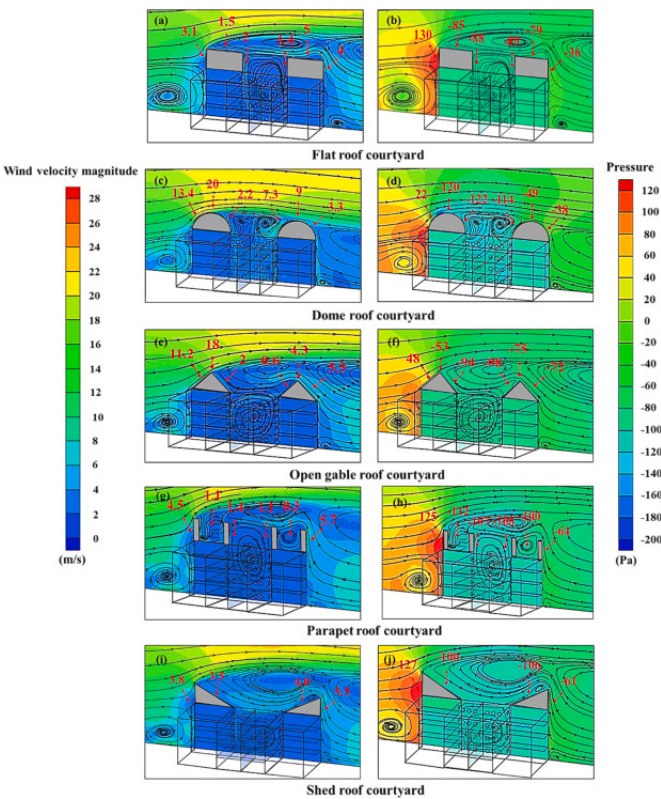
Developing design

Roof

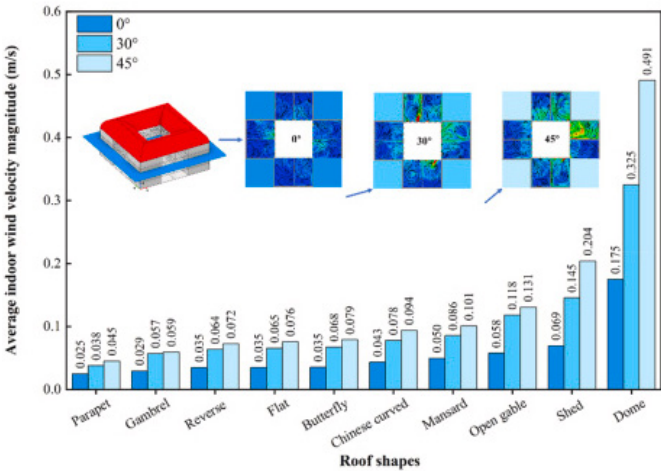
An aluminium additional roof is added on top of the structural (full-fledged) roof. The upper roof is light-weight and does many things: its sloped shape guides the air into the street (Nosek et al., 2021), and increases the natural ventilation inside the patios, and inside the dwellings also (Sun et al., 2025). Besides that, aluminium reflects UV-radiation, especially when an acrylic coating is used. Because the upper roof layer warms up thanks to the sun, the air between the layers gets hotter. The shape allows the air to escape.

The roof is not designed too steeply, for it would unnecessarily increase the building's height in this already dense neighbourhood.

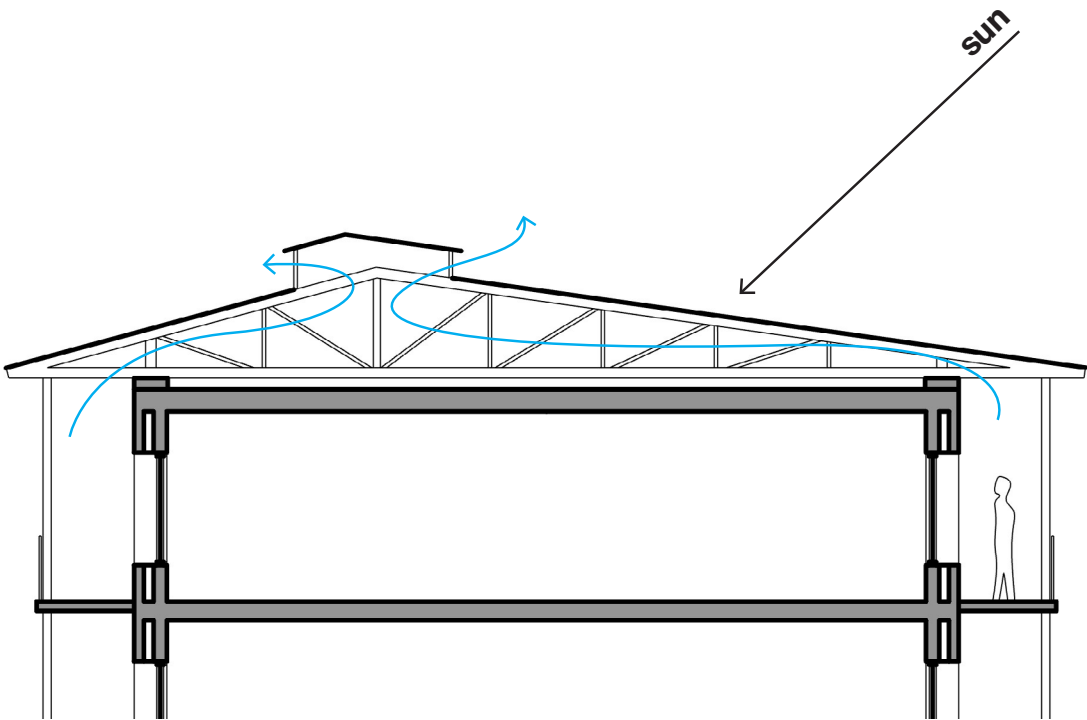
The roof could allow for possible UV panels in the future.



Airflow at 0° movement patterns and pressure contours for five different roof styles with specific values. From Sun et al. (2025).



Comparison of average indoor wind velocity magnitude across ten roof shapes under three different wind directions. From Sun et al. (2025).



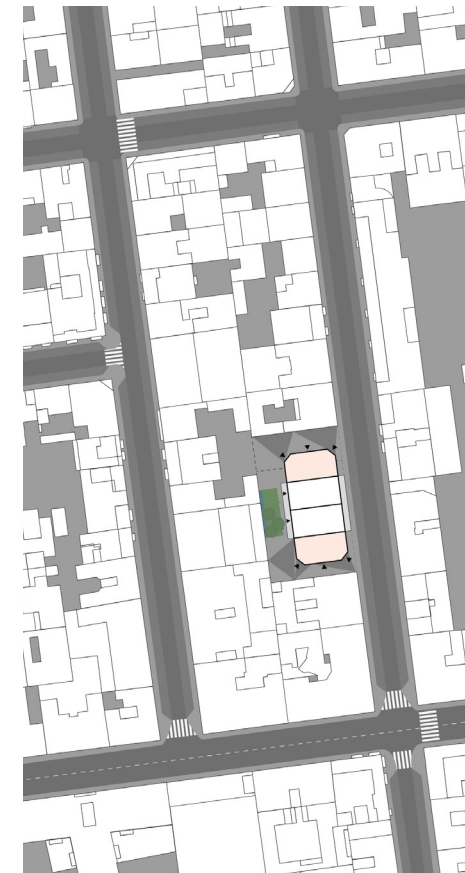
Aluminium roof with acrylic coating has a high UV reflectivity. From "What Is the Best Coating for Metal Roofs?" (Perfect Exteriors, 2024)

Design drawings

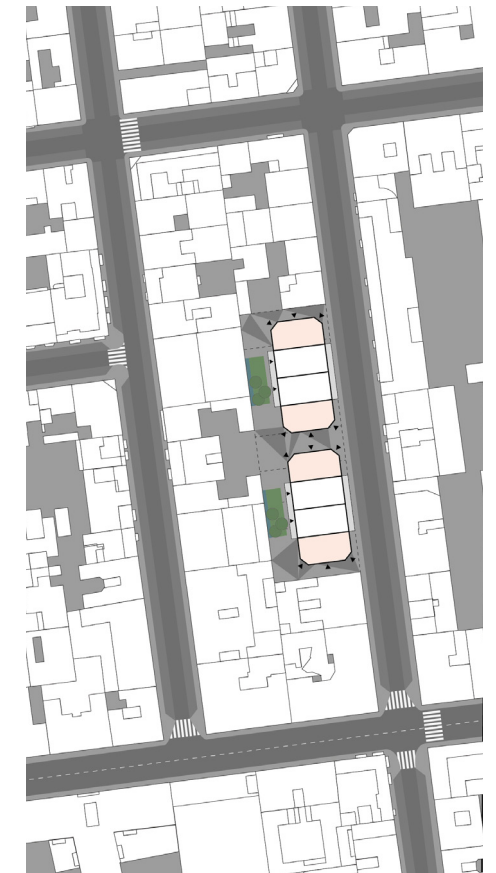
Urban embedding



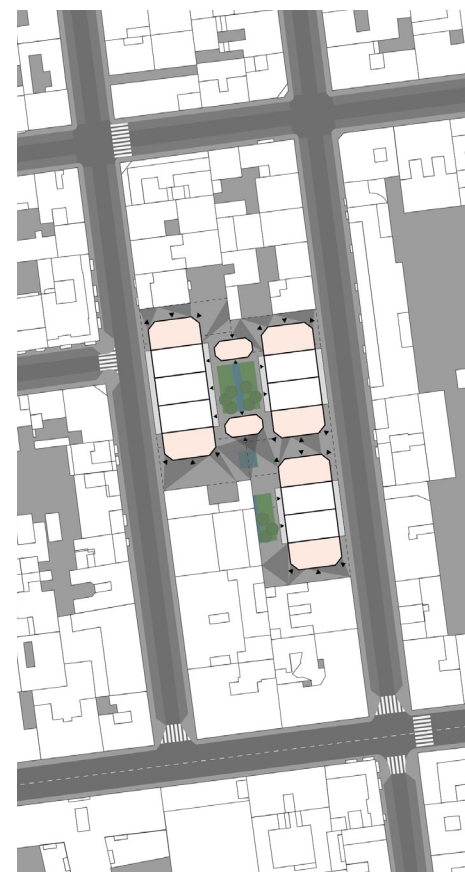
1. Existing situation



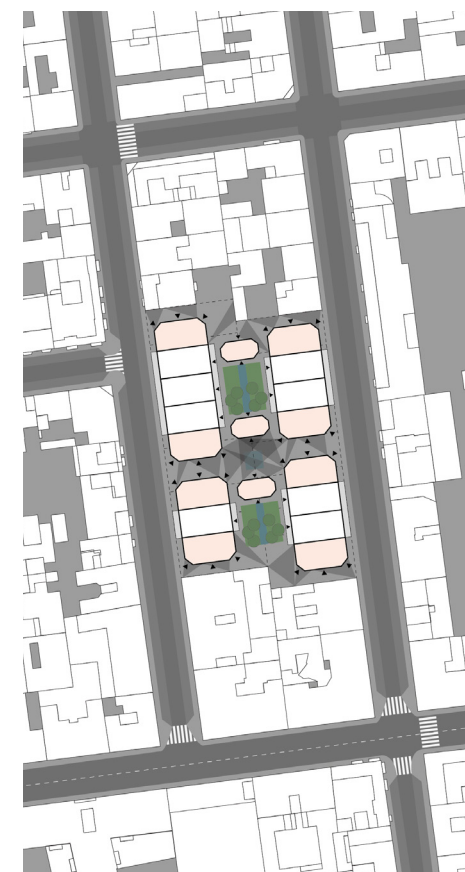
2. First intervention: small semi-public courtyard that is accessible via the gateway giving the block to opportunity to 'breathe'



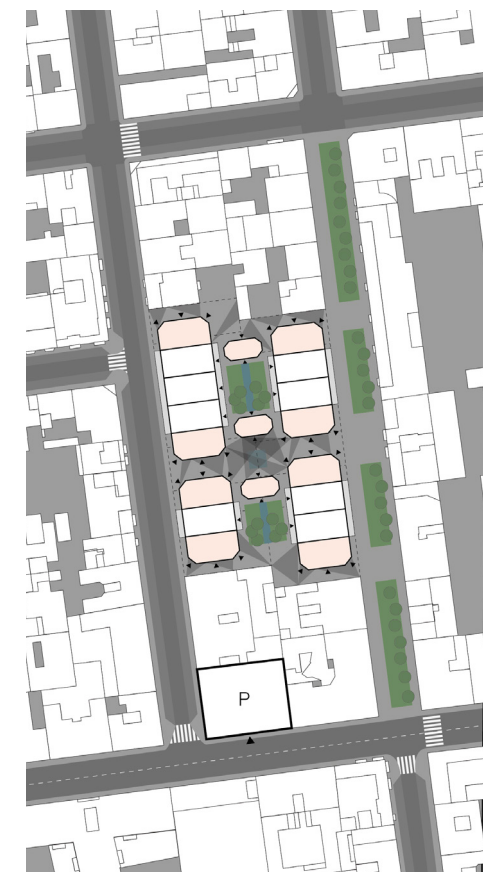
3. New mini-block next to it: courtyard is extended and passageway is more activated. Sunscreens can be adjusted



4. Development on the opposite side allows for a surrounded courtyard, that can now become more private. The now formed passageway still is public.



5. As this continues, spaces become more defined. The shared spaces in between function as a climate refuge, at the intersection of the public and private sphere.

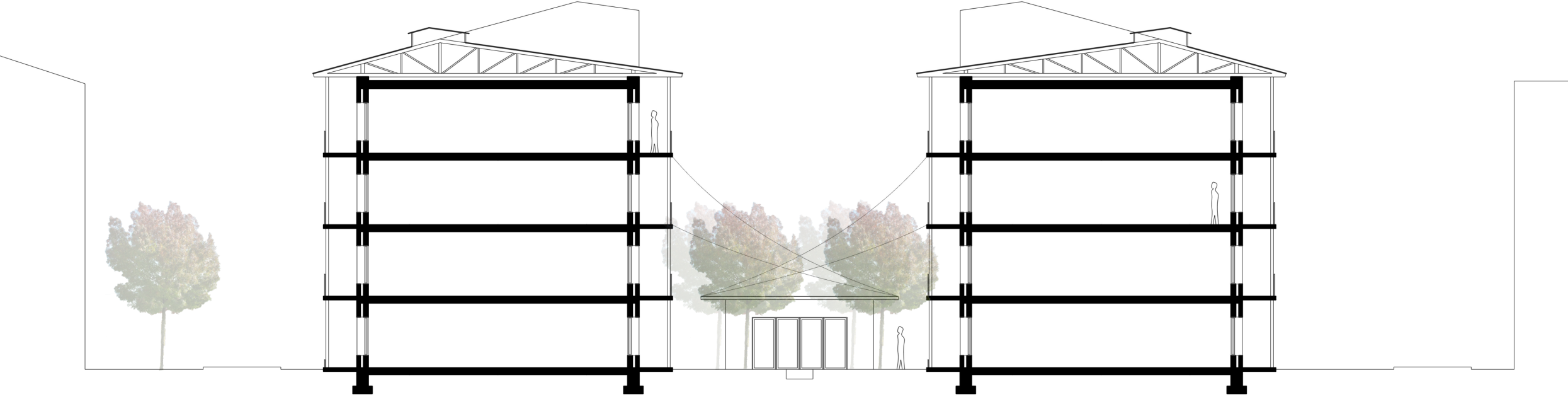


6. When developing the southern side of the block, more concentrated car parking is possible. This allows for parking space on the street being removed.

Section A
1:200



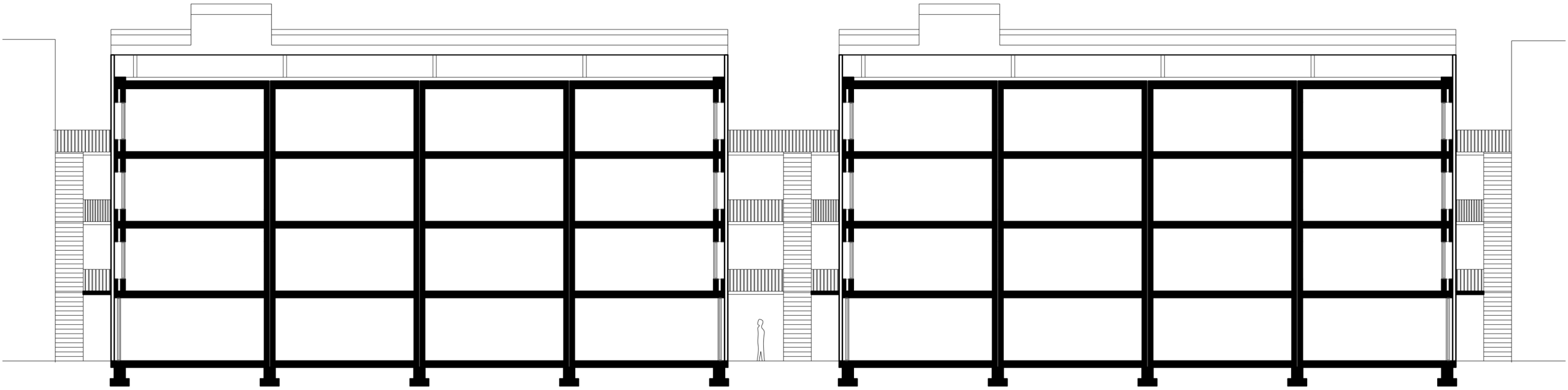
Section B
1:200



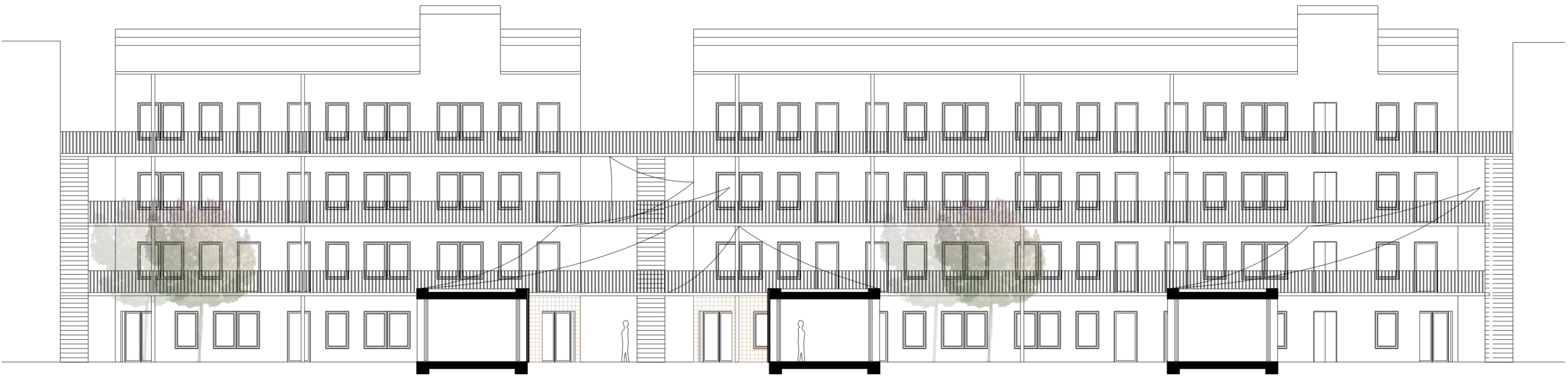
East facade
1:200



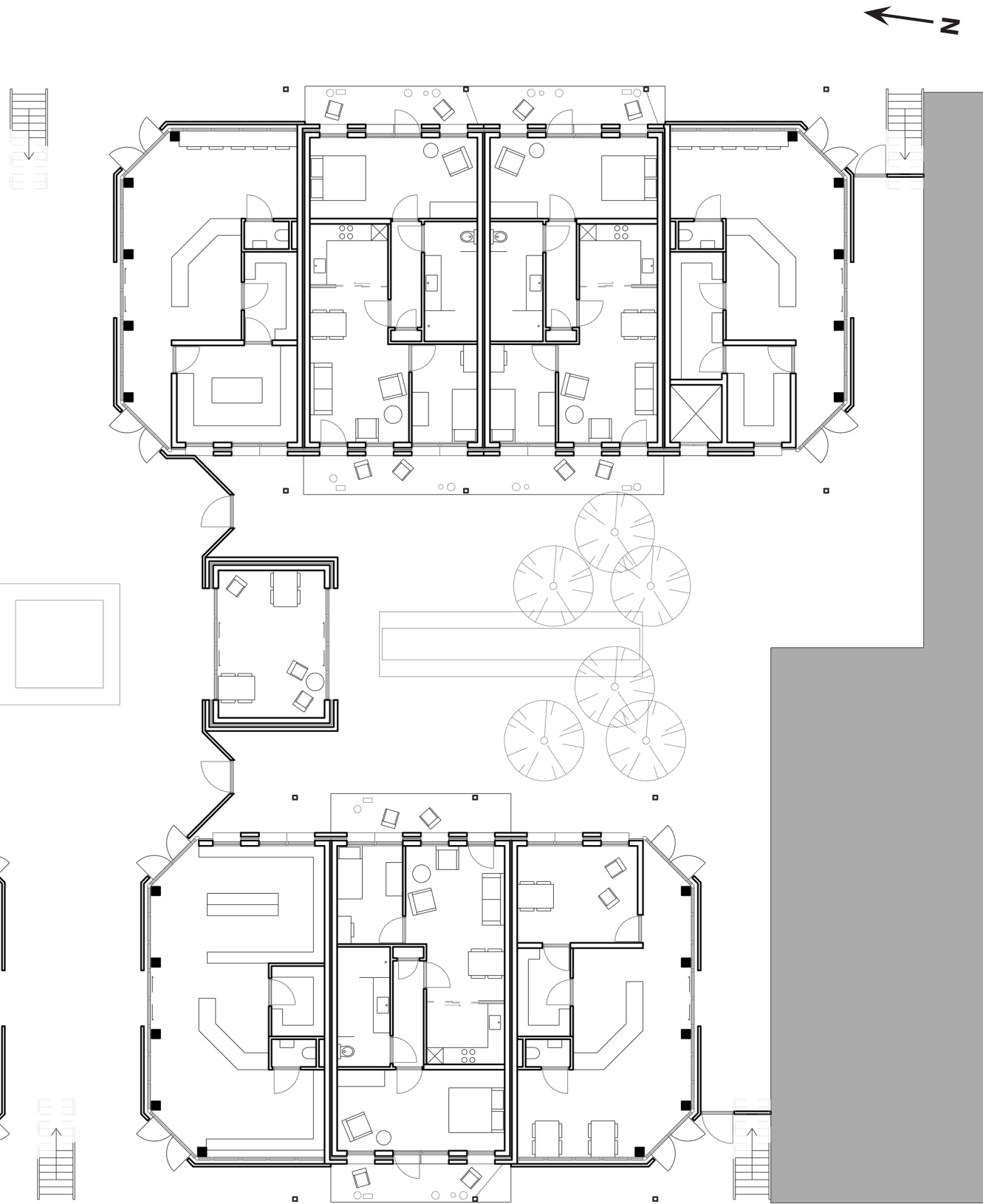
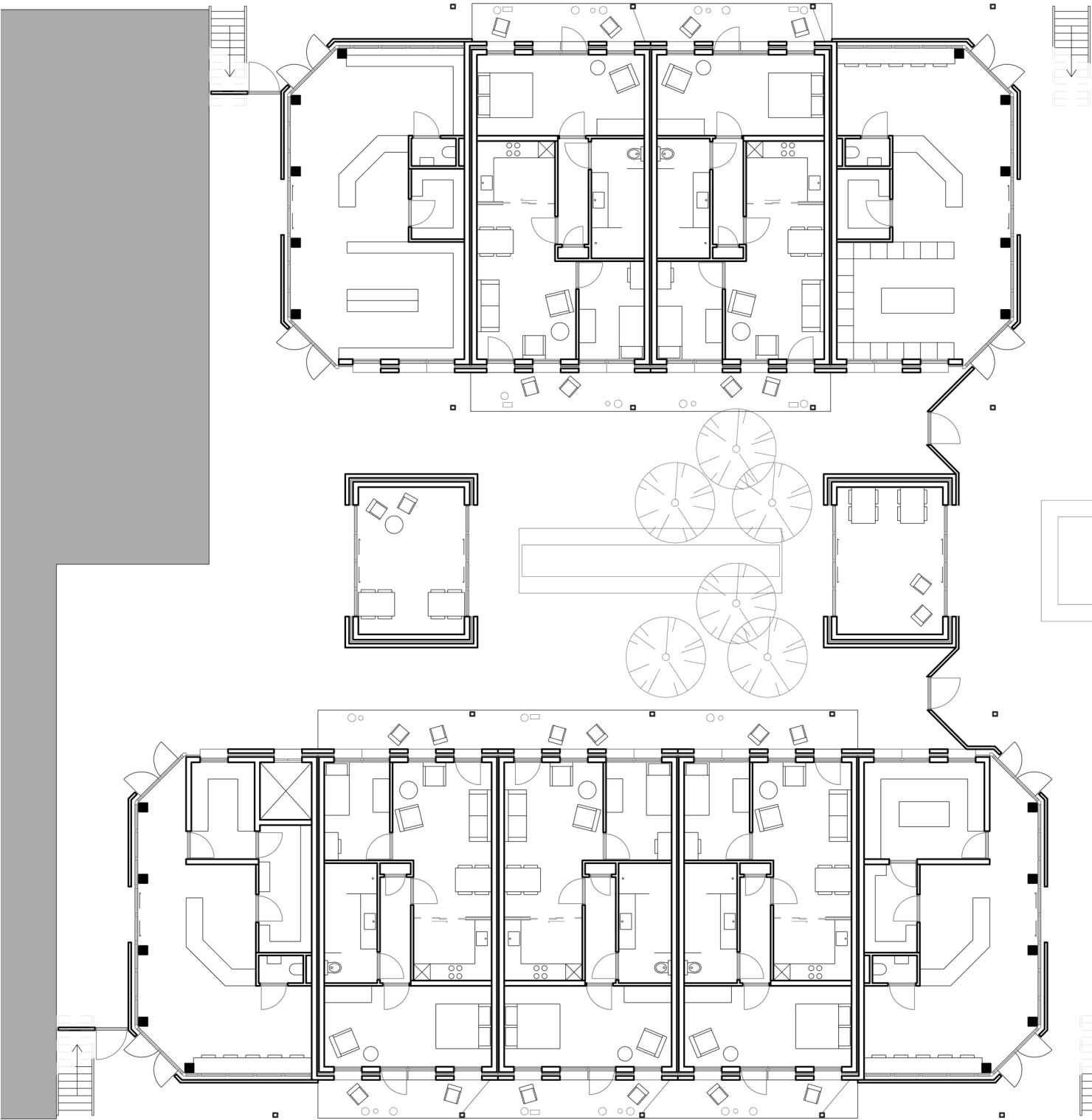
Section C
1:200



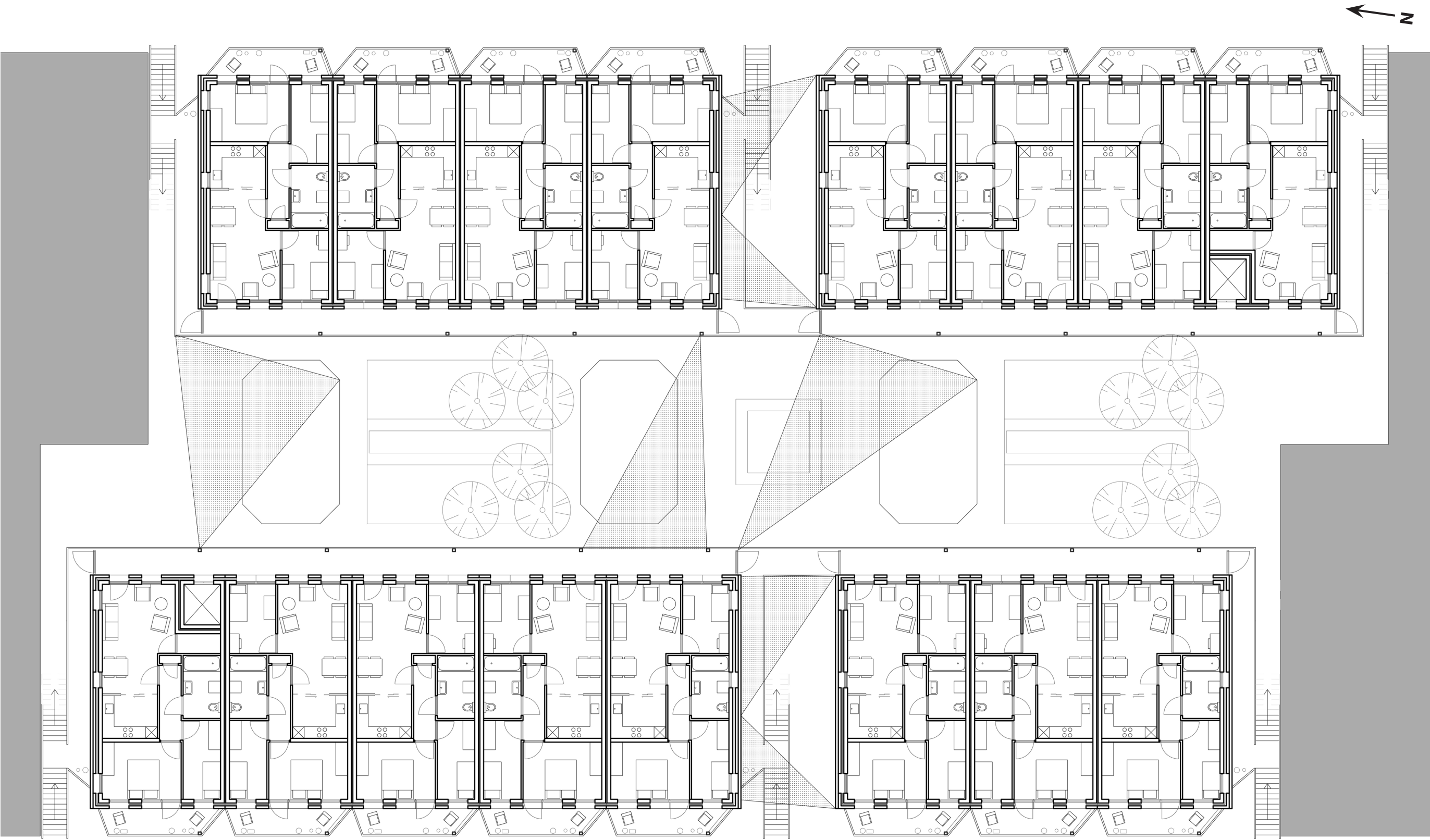
Section D
1:200



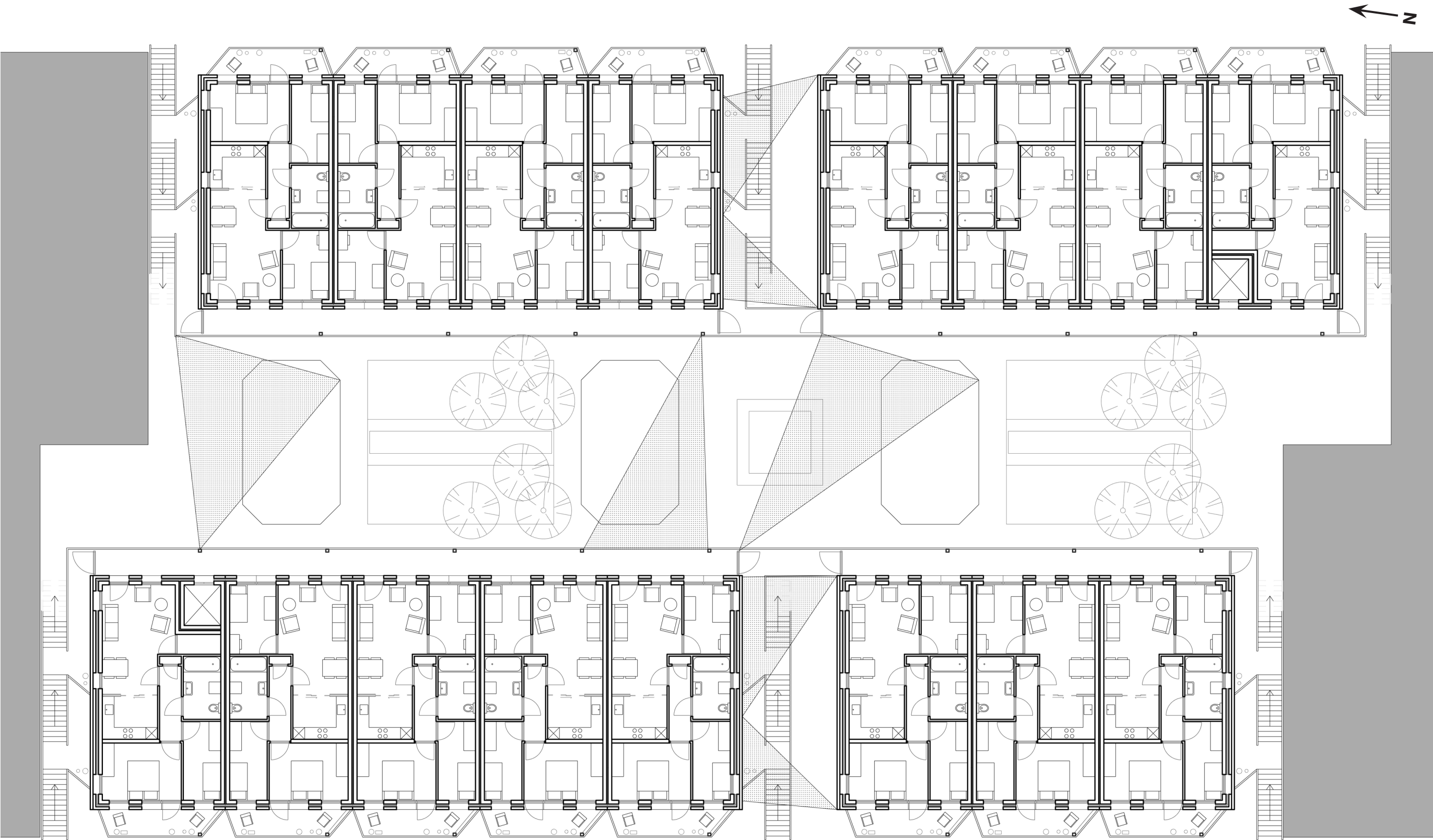
Ground floor
1:200



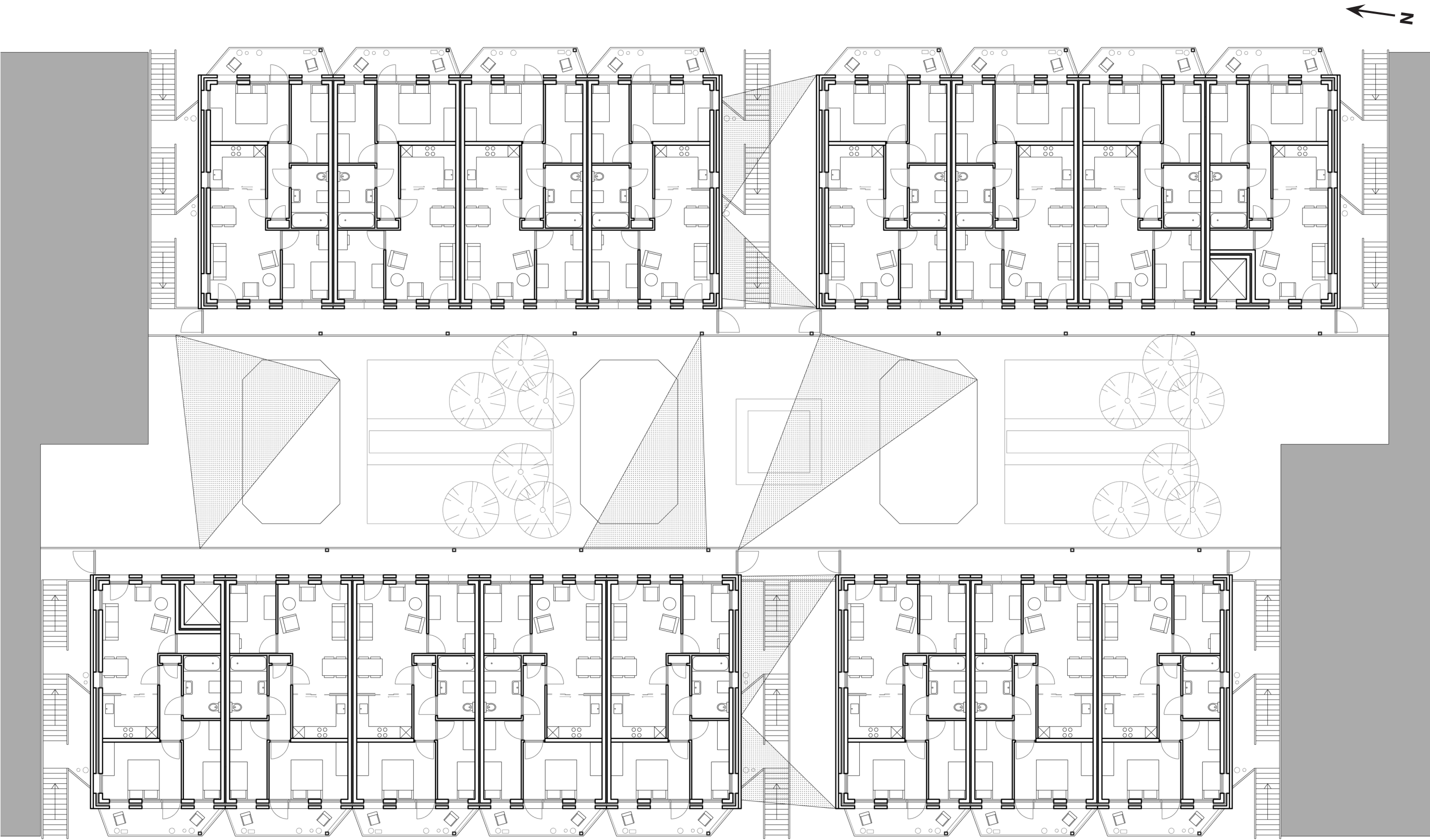
First floor
1:200



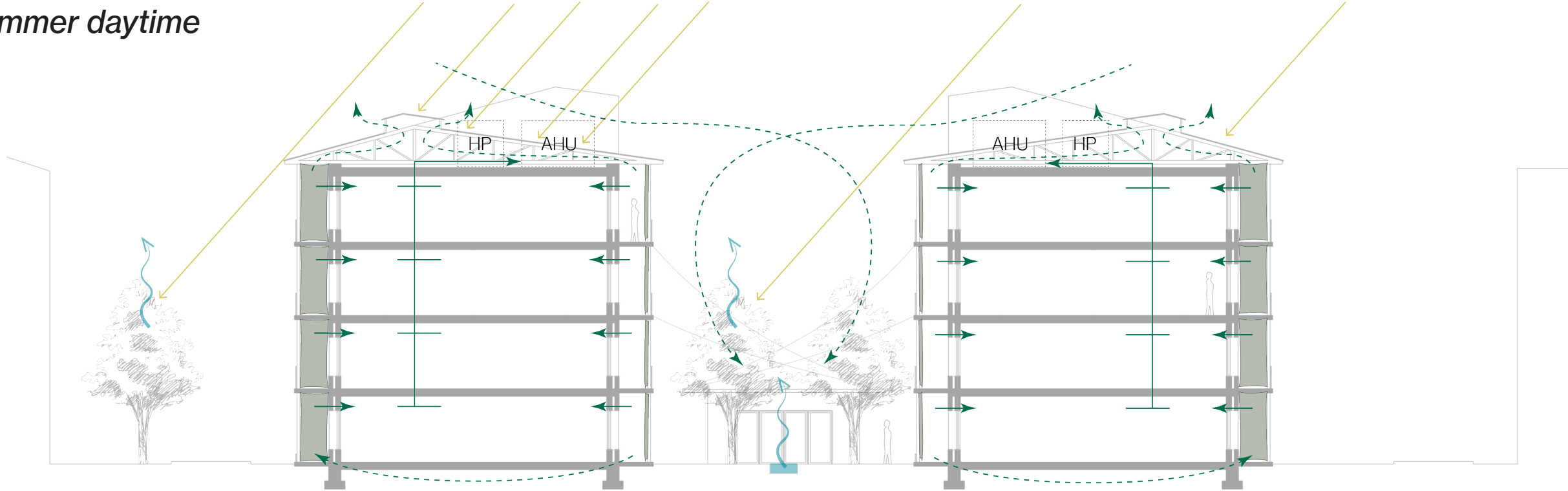
Second floor
1:200



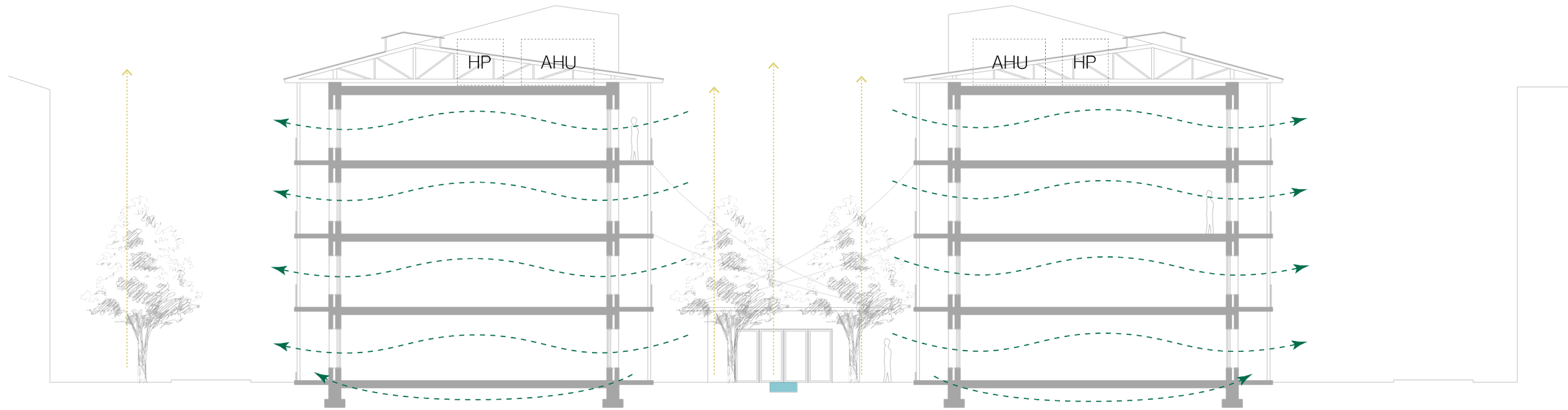
Third floor
1:200



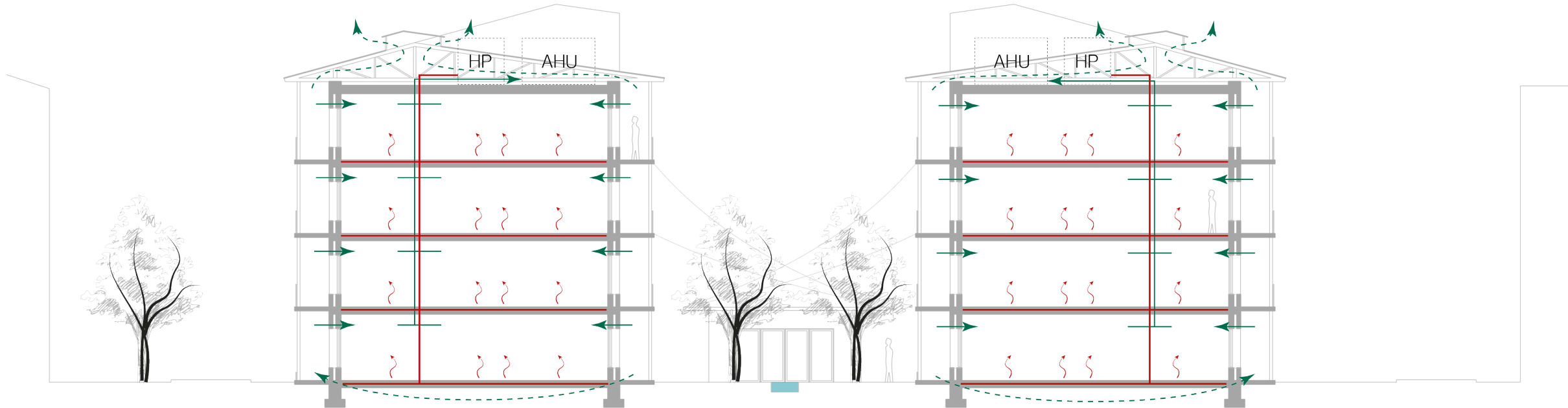
Climate summer daytime
1:200



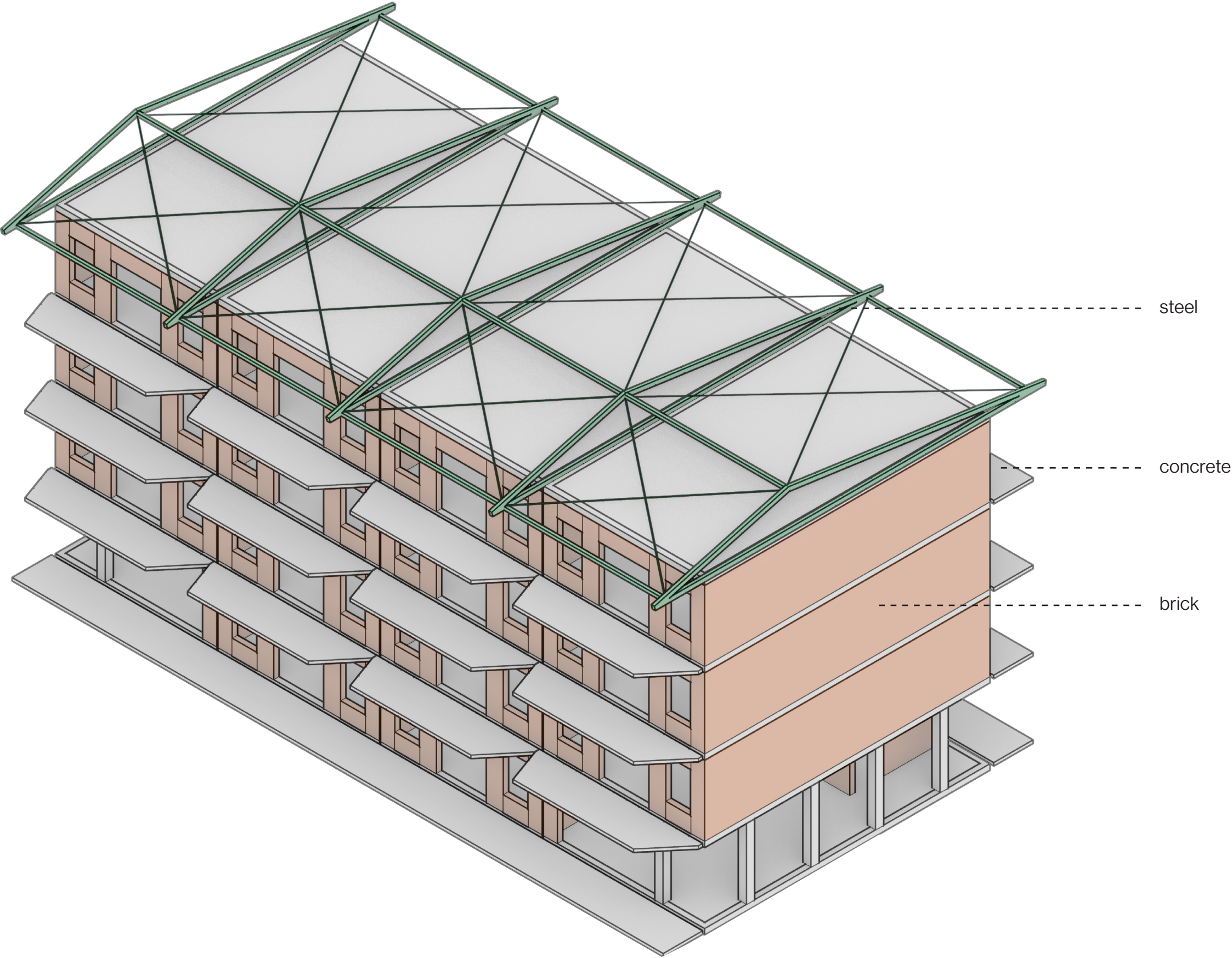
Climate summer nighttime
1:200



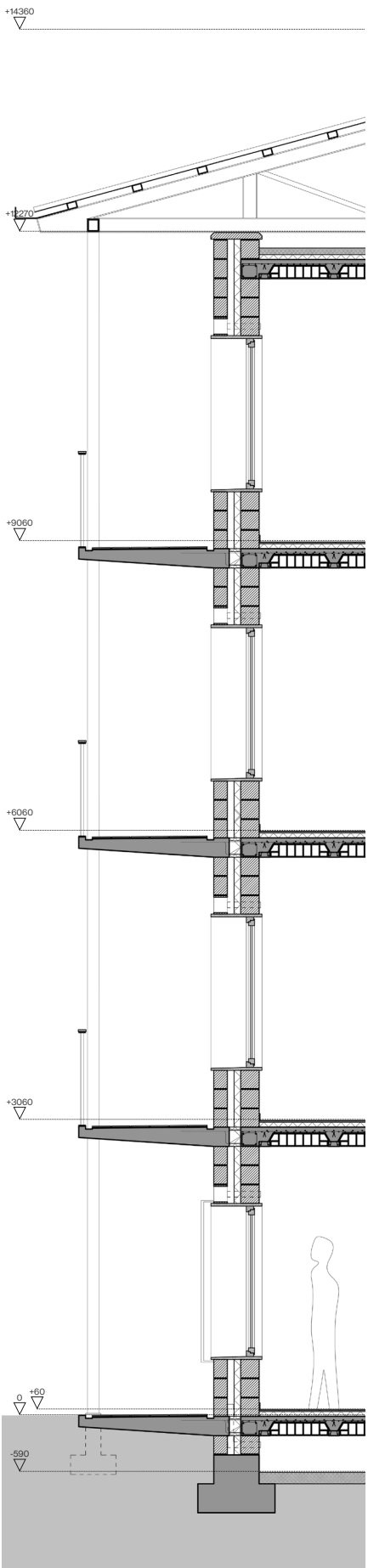
Climate winter
1:200



Construction principle

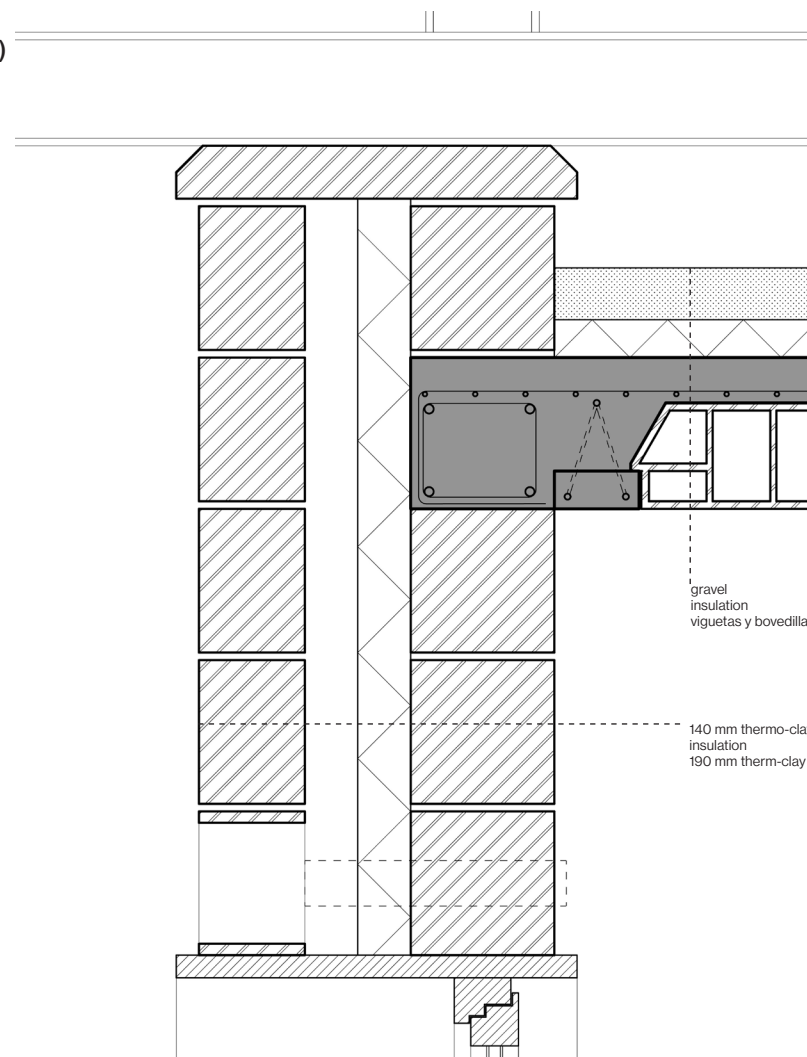


Facade fragment

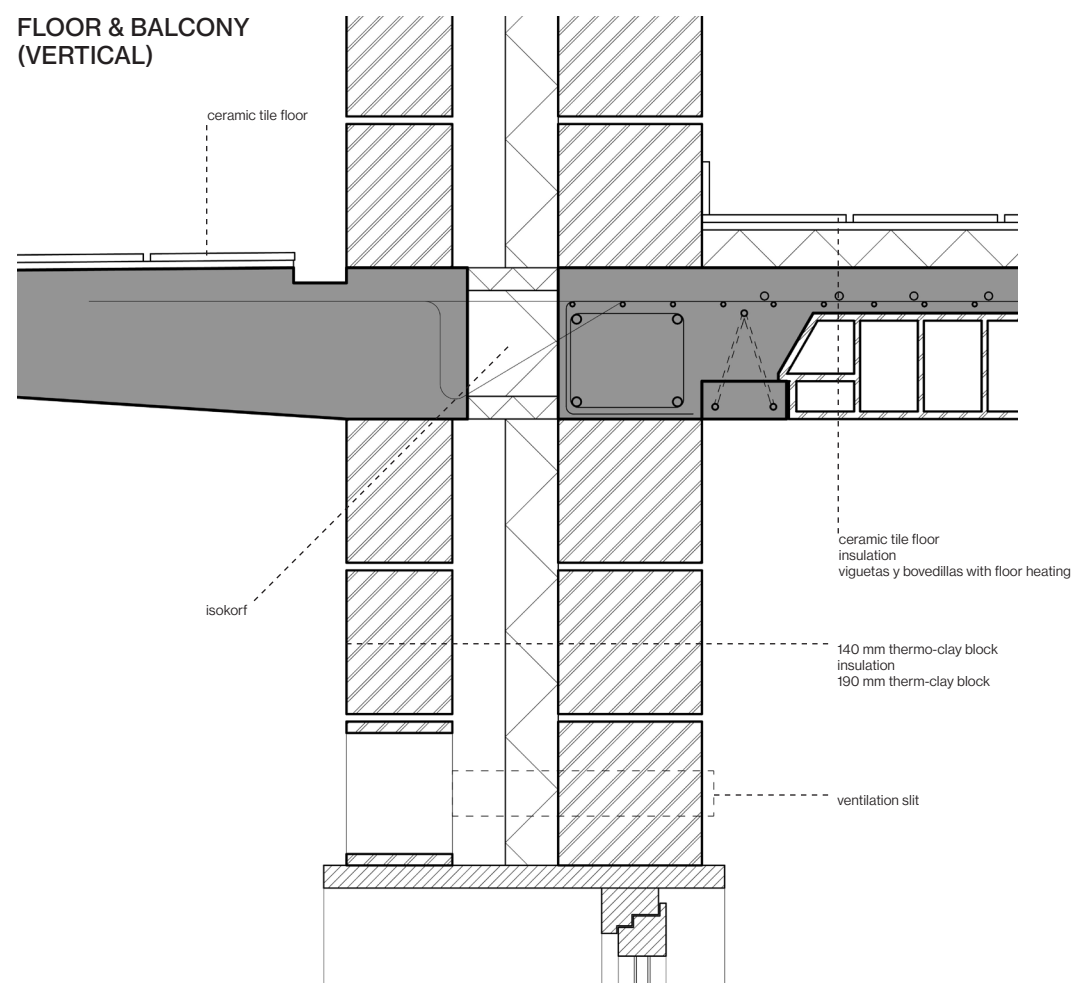


Details 1:10

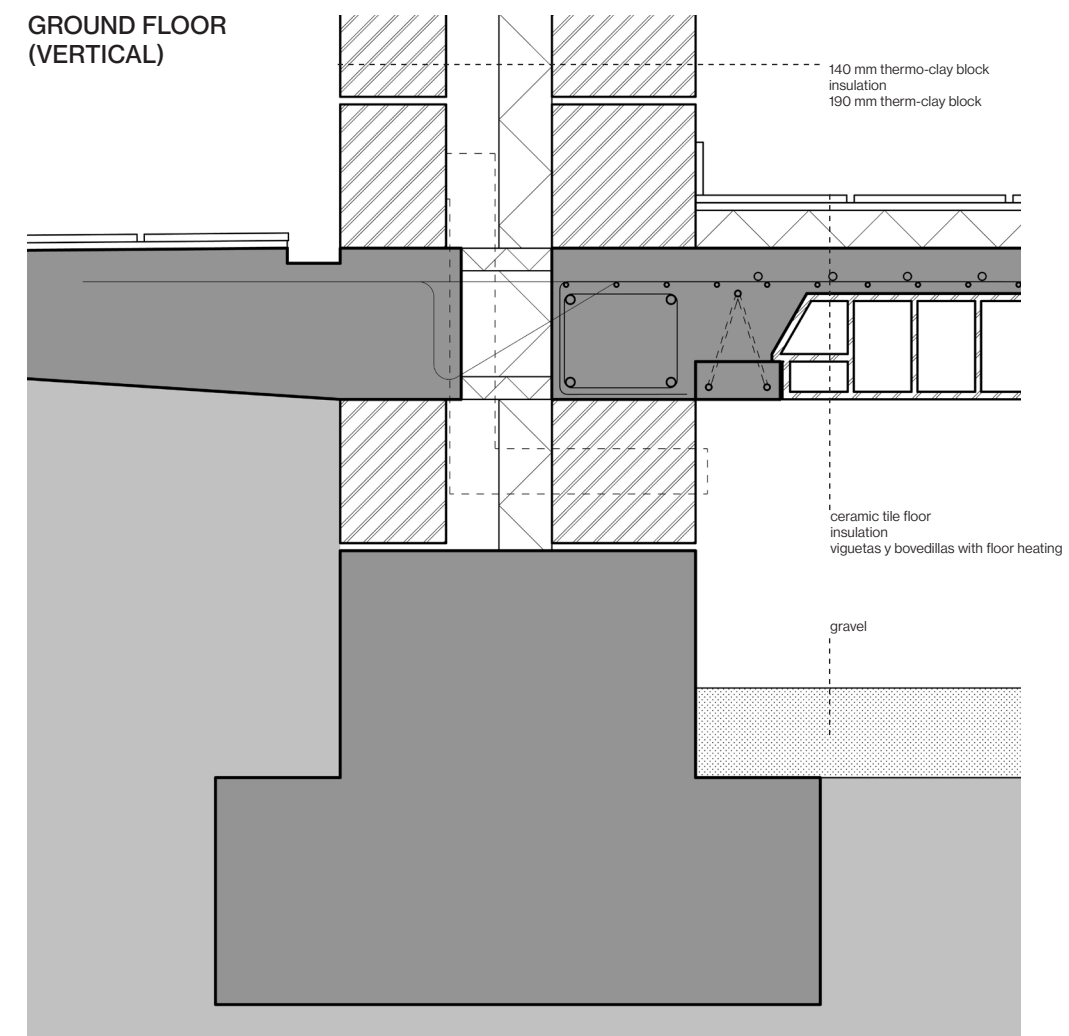
ROOF (VERTICAL)



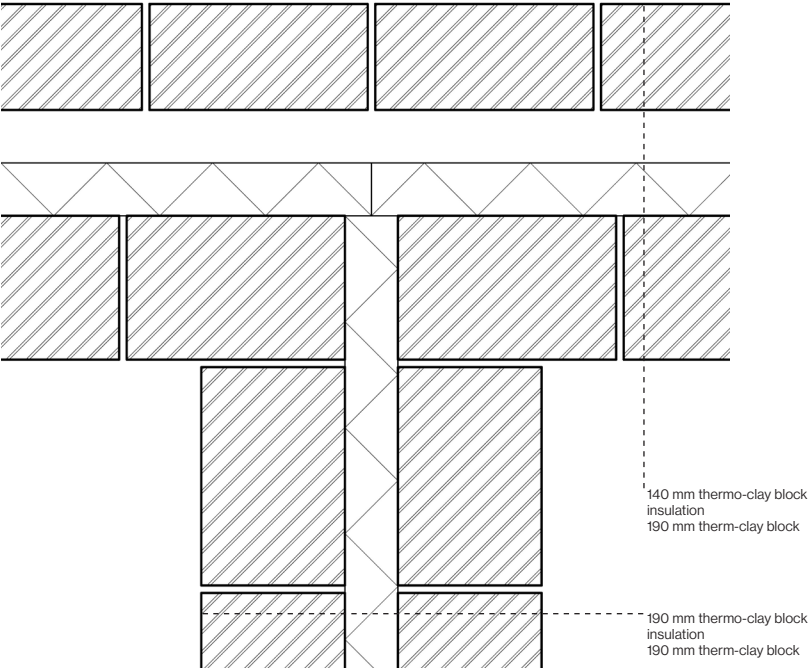
FLOOR & BALCONY (VERTICAL)



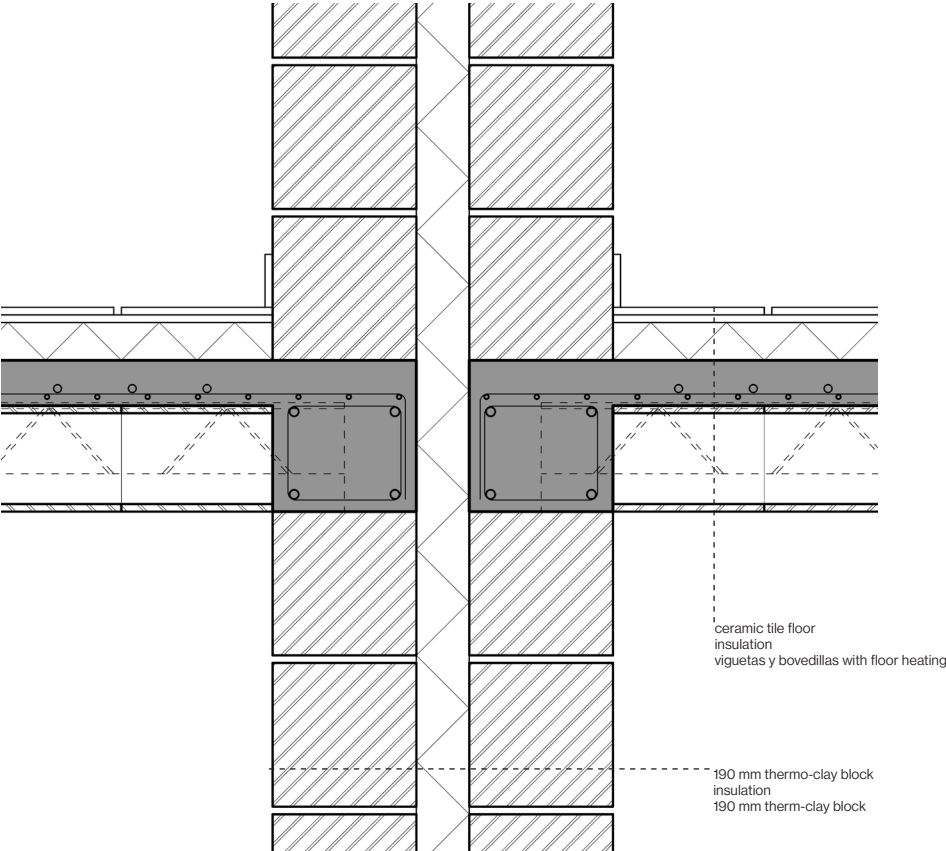
GROUND FLOOR (VERTICAL)



WALLS MEETING
(HORIZONTAL)



WALLS MEETING
(VERTICAL)



Part 4.

Conclusion and discussion

Conclusion

The question this project intended to answer was: How can an architectural intervention promote thermal commoning in a neighbourhood experiencing heat vulnerability?

Firstly, diffusing the barrier between the public and private spheres is important. In this way, the privatisation of air-conditioned spaces can be countered. In Pradolongo and Madrid, it was about opening up the closed building blocks with the hidden, cool courtyards.

Also, it helps to build on the existing social infrastructure already present in a neighbourhood. The amenities of Pradolongo now embody a more meaningful refuge than before.

The balcony functions very well as a buffer space. Not only a social one, but also a thermal one. They have the task of protecting your home from heat, but also encourage you to interact with what is outside.

Sun shading often means a barrier between the outside and inside. But a conscious design for a location-specific sun pattern can reduce the amount of sun shading needed. It should also be easy to remove, allowing for more openness when possible.

Implications / recommendations

The project emphasizes the problem of energy poverty. Thermal commoning offers a solution to the economic problem. But it does more than that: there is a societal problem underneath energy poverty, a 'survival of the fittest' mentality. That is the true reason for encouraging thermal commoning. A common resilience.

Heat waves will grow worse over time. The topic is therefore becoming increasingly relevant, and architects will need to position themselves. It is not only a matter of technical solutions, but it also says something about society as a whole.

Studying Madrid and how the problem manifests itself in this city is like a look to the future for colder areas of the world.

The project shows how, in a low-income neighbourhood, heat resilience can be created (or found?) through encouraging thermal commoning. However, heat waves are still natural disasters, and there is no magic pill. Mechanical cooling is still appreciated in such conditions. Furthermore, the project engages with a specific context and climate. To apply the same design approach elsewhere, research on that particular context. Especially since it is about social infrastructure and passive climate design.

Reflection

The graduation process was very interesting. Diving into the topic of heat resilience, it was difficult to navigate between the economic, technical, social, and philosophical sides of the story. Its potential for becoming a design with many layers was clear from an early point on. However, the complexity that would come with it was overwhelming at times.

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